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MINUTES OF CONFERENCE ON THE EPIDEMIOLOGY OF AIR POLLUTION HELD AT WASHINGTON, D. C. ON SEPTEMBER 14, 1956

Public Health Service
Washington, D. C.

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Meetings - Epidmiology of Air Poll.

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Minutes of Conference

on the

EPIDEMIOLOGY OF AIR POLLUTION

Held at Washington, D. C.

on September 14, 1956

AIR POLLUTION MEDICAL PROGRAM

Division of Special Health Services
Bureau of State Services
Public Health Service

U. S. DEPARTMENT OF

HEALTH, EDUCATION AND WELFARE

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These minutes were edited by
Dr. Harry Heimann, Chief,
Operational Research Section
Air Pollution Medical Program
Division of Special Health Services

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Dr. Wilton M. Fisher, Chief, Air Pollution Medical Program

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R. S. Hollingshead, Program Management Officer, Air Pollution Medical Program

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Discussion Outline reference:

"Do we now have adequate methods for measuring morbidity in a community in relation to air pollution?"

C. Problems in the design of air pollution studies:

Discussion Outline reference:

"What problems exist in the application of available epidemiologic methods to air pollution projects?"

DISCUSSION OUTLINE

Problems in the Epidemiology of Air Pollution

A. The overall objective of epidemiologic studies in air pollution is to determine:

Does long-term exposure to air pollutants of various types and amounts cause and/or modify human disease, and if so, to what extent?

Consideration of this objective raises three broad questions:

1. Are there specific diseases caused by air pollution?
2. Are there diseases that occur more frequently in individuals exposed to air pollution than in those who are not exposed?
3. Are there diseases which are aggravated by exposure to air pollution?

B. In determining how to answer the above questions, we must consider:

Do we now have adequate methods for measuring morbidity in a community in relation to air pollution?

If the consensus of advisory opinion is that we do not, we will require assistance on the following problems:

1. To what extent should we initially concentrate on methodological development?
2. How should the development of improved methodology be approached?
3. How can we determine the proper allocation of resources between methodologic development and operational epidemiologic studies.

C. If it is agreed that we possess adequate methods for measuring community morbidity, we may then consider:

What problems exist in the application of available epidemiologic methods to air pollution projects?

Problems about which we are particularly anxious to secure advice include:

1. How do we determine "exposures" of communities to air pollution?

2. What are the advantages and disadvantages of various methods for measuring "sickness" in a community?

3. How can "residence history" (used as an indicator of exposure to air pollution) most readily be obtained?

4. What would constitute adequate control groups in air pollution studies:
   For example, different areas, different year, etc.?

5. What area units are best for comparison of data?

   a. Counties
   b. Standard metropolitan areas
   c. "Economic Subregions"
   d. Marketing areas
   e. Census tracts
   f. Others

6. What are the advantages and disadvantages of using "captive populations? (prison, asylum, etc.) vs. "free populations?

7. What are the advantages and disadvantages of retrospective vs. prospective studies?

8. What are the advantages and disadvantages of the following approaches?

   a. Studies of relatively small numbers of individuals, on whom will be obtained the maximum amount of information, including detailed medical examination.

   b. Studies of somewhat larger numbers, but with the medical information limited to that obtainable by "screening" procedures.

   c. Studies of large numbers of individuals, based on review of records, interviews, and other similar techniques.

9. How much emphasis should be devoted to analyzing data already available in various communities rather than collecting new data?

10. On a preliminary basis, we have looked into Veterans Administration, Social Security, Vital Records office and insurance company data. How can these data be used most effectively? What has been the experience of the consultants

in using these sources? (For example, we are particularly interested in the possibilities of a retrospective study of VA data.) What local agencies should we work with in trying to locate data on sickness?

11. What disease entities or organ systems should be approached first?

12. What are the advantages and disadvantages of concentrated studies in "single industry" towns as compared to studies of towns with diversified industry? If single industry towns should be studied, what are the most significant industries for initial survey? What towns would be suitable?

13. What types of agencies or institutions might best conduct (or participate in the conduct of) such studies? Universities? (what departments?), Health Departments, industrial or other health services? How can we assist in developing and coordinating the "team" approach that may be required? (There will probably be instances when the agency or institution can conduct only medical studies. Do the consultants agree that the Service should provide the necessary statistical and/or engineering assistance?)

ATTENDING CONFERENCE

Dr. David E. Price, Assistant Surgeon General, PHS

Dr. Elton E. Osborne, Assistant Chief, Division of Special Health Services, PHS

Dr. Wilton M. Fisher, Chief, Air Pollution Medical Program, PHS

Dr. Harry Heimann, APMP, PHS

Mr. Robert S. Hollingshead, APMP, PHS

Mr. Nicholas E. Manos, APMP, PHS

Mrs. Geraldine Gleeson, APMP, PHS

Mrs. Gail Fisher, APMP, PHS

Mr. A. Patrick Iskrant, Accident Prevention Program, PHS

Dr. George Comstock, Special Health Services, TBP, PHS

Dr. Clark Cooper, Occupational Health Field H.Q., PHS, Cincinnati, Ohio

Dr. Wilfred David, Special Health Services Consultant, Region IX, DHEW

Dr. Ralph S. Paffenbarger, Robert A. Taft Sanitary Eng. Center, Cincinnati, Ohio

Dr. Alexander G. Gilliam, National Cancer Institute, PHS

Dr. William S. Baum, National Cancer Institute, PHS

Dr. Thomas Dublin, National Institutes of Health, PHS

Dr. Ross L. Gauld, Dept. of Epidemiology, Walter Reed Army Inst. of Research

Dr. Seymour Jablon, National Academy of Sciences, National Research Council

Dr. Thomas F. Mancuso, Div. of Industrial Hygiene, Ohio Department of Health

Dr. Frederick H. Wentworth, Div. of Communicable Diseases, Ohio Dept. of Health

Dr. Lester Breslow, Bureau of Chronic Diseases, California Dept. of Public Health

Dr. Morris Kleinfeld, Div. of Industrial Hygiene, New York Department of Labor

Dr. W. W. Frye, Louisiana State University School of Medicine

Dr. Antonio Ciocco, School of Public Health, University of Pittsburgh

Dr. John Gordon, School of Public Health, Harvard University

Dr. Lloyd Florio, Department of Public Health, University of Colorado

Dr. Charles E. Smith, University of California School of Public Health (Berkeley)

RESEARCH PROJECTS

AIR POLLUTION MEDICAL PROGRAM

DIVISION SPECIAL HEALTH SERVICES

September 1956

H. Heimann 9/56

EPIDEMIOLOGIC STUDIES

1. Not Specified as to Disease or Organ System Involved

A. General

I. Studies of mortality patterns

Program Operations (In planning stage) Air Poll. Med. Program	a.	Intra-city comparisons (e.g. by census tracts) with correlations against air pollution indexes.	1
Program Operations (In planning stage) Air Poll. Med. Program	b.	Inter-city comparisons of O.A.S.I. data.	2
Contract + Program Op. (In process) NIH (PHS) + Air Poll.Med.Pro.	c.	Inter-city and urban-suburban-rural comparisons, with correlations against air pollution indexes.	3
Program Operations (In planning stage) Air Poll. Med. Program	d.	In relation to socio-economic status	4

II. Studies of morbidity patterns

Research Grant (In process) Detroit City Health Dept.	a.	Intra-city comparisons, with correlations against air pollution indexes. (Detroit-Windsor)	5
Program Operations (In process) Air Poll. Med. Program	b.	Effect of a "prime" industrial contributor to community air pollution, upon morbidity (and mortality) pattern of the community.	6
? Contract + Prog. Op. (In planning stage) Div. Publ. Hlth. Methods (PHS) + Air Pollution Med. Program	c.	Inter-community comparison of morbidity, with correlations against air pollution indexes.	7
? Contract or Demonstration (In planning stage) Calif. State Health Dept.	d.	Intra-city comparison by place of residence, with correlations against air pollution indexes. (Los Angeles)	8
(In planning stage)	e.	Morbidity patterns in "single-industry" communities.	9

Contract (In process) Univ. Pitts.	B.	Sequelae of an acute episode of non-specific air pollution of an irritant nature some 8 years after the episode. (Donora, Pennsylvania)	10

2. Specified as to Disease or Organ System Involved

A. Cardio-respiratory system effects

I. Lung cancer

Contract (In planning stage) Armed Forces Inst. Path.	a.	Correlation of histologic type of lung cancer with air pollution indexes.	11
Contract + Program Op. (In planning stage) N.C.I. + Air Poll. Med. Program	b.	Relationship of current cancer mortality to air pollution indexes.	12
Program Operations (In planning stage) Air Poll. Med. Program	c.	Significance of Country of origin in lung cancer frequency.	13
Contract (In planning stage) Armed Forces Inst. Path.	d.	Metaplastic changes of tracheobronchial epithelium (and its relationship to bronchial cancer) correlated against air pollution indexes.	14

II. Chronic lung disease, other than cancer

Contract + program op. (In planning stage) Veterans Adm. + Air Poll. Med. Program	a.	Correlation of incidence of non-tuberculous chronic lung disease against air pollution indexes, (Veterans Admin.)	15
(In planning stage)	b.	Relation of fluctuant levels of air pollution (in a "highly polluted community") to exacerbations of chronic lung disease (e.g. bronchial asthma).	16
(In planning stage)	c.	Relationship of non-specific (chemical) irritant air pollution to "Yokohoma asthma".	17

Research Grant (In process) Univ. Cincinnati	d.	Influence of fluctuant levels of air pollution upon the clinical course of persons with functional impairment of the cardio-respiratory system.	18
Research Grant (In process) Univ. Southern Calif.	e.	Influence of fluctuant levels of air pollution upon pulmonary function, measured by a "standard" test, in both "normal" people and those with functional impairment of the cardio-respiratory system.	19
? Contract (In planning stage)	f.	Influence of air pollution upon pulmonary function, measured by a "standard" test in large population groups.	20
Program Operations (In planning stage) Air Poll. Med. Prog.	III.	Study of the course of heart disease as influenced by air pollution indexes.	21
(In planning stage)	B.	The significance of air pollution in the induction of morphologic, genetic, or physiologic changes of the bacterial flora of the upper respiratory tract.	22
Research Grant (In process) Utah State Agr. Coll.	C.	The effects of airborne fluoride salts upon man	23

TOXICOLOGIC STUDIES

1. Not Specified as to Disease or Organ System Involved

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Contract (In process) Div. Occ. Hlth. (PHS)	C. Study of chemical analytical procedures needed in the associated toxicologic studies of air pollutants	26
Contract (In process) Div. Occ. Hlth. (PHS)	D. Toxicologic study of air pollutants	27
Contract (In planning stage) Miami Univ.	E. Toxicologic screening of air pollutants	28
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Research Grant (In process) Coll. Med. Evangelists	IV. Effect of air pollutants upon animal tissue cultures, modified by influenza virus	33
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Contract (In process) Div. Occ. Hlth. (PHS)	II. Toxicity and mode of action of ozone	35
Research Grant (In process) Harvard University	III. Toxicity and mode of action of sulfur oxides (sulfur dioxide and sulfur trioxide)	36
Research Grant (In process) Univ. Calif. L.A.	IV. The relation of air pollution (Los Angeles) to lung infection	37
Contract (In planning stage) Vanderbilt Univ.	V. The relation of air pollution (soft coal smoke) to lung function changes	38
	VI. Developmental procedures	
Research Grants (In process) Univ. Pittsburgh	a. Study of differential in lung function effects of lung parenchymal irritants	39
Contract (In process) Div. Occ. Hlth. (PHS)	b. Study of mechanism of lung parenchymal irritants	40
? Contract (In planning stage) Armed Forces Inst. Path.	VII. Study of metaphasia of epithelium of tracheobronchial tree due to air pollutants	41

Research Grant (In process) Univ. South. Calif.	VIII. Carcinogenicity of air pollutants (Los Angeles)	42
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Program Operations (In planning stage) Air Poll. Med. Program	B. Patterns of population migration	46

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CONFERENCE ON THE EPIDEMIOLOGY OF AIR POLLUTION

Friday, September 14, 1956

The Conference on the Epidemiology of Air Pollution called by the Air Pollution Medical Program, Division of Special Health Services, Bureau of State Services, U. S. Public Health Service, convened at 9:50 a.m. in Room G755 North Building, Department of Health, Education and Welfare, Washington, D.C., Dr. Wilton M. Fisher, Chief, Air Pollution Medical Program, presiding.

DR. FISHER: If we may, we shall start this session and introduce Dr. Elton Osborne, Assistant Chief of the Division of Special Health Services.

DR. OSBORNE: We are pleased that you gentlemen have found the time to come to give us the benefit of your advice.

The Air Pollution Medical Program of the Division of Special Health Services is only part of the air pollution picture in the Public Health Service. I am sure that most of you are familiar with the fact that the Division of Sanitary Engineering Services has a very active program along these lines. In that activity they are interested in developing methods for the abatement of air pollution. In our Division we have the responsibility for making studies to determine how air pollutants affect the human body.

The emphasis on air pollution first began in this Country when the acute episode accurred in Donora in 1948. Prior to that there had been moderate interest, and Donora seems to have pointed it up. Another episode, as you know, occurred in the Meuse Valley in Belgium. In 1950 and in 1952 London had rather severe acute episodes. Los Angeles has been having problems, I believe, since about 1938, finally becoming acute in 1947 and 1948.

Following these acute episodes and the severe problem which developed in Los Angeles, the Federal Government on the order of the President set up an Interdepartmental Committee to consider the subject of air pollution. This was in 1954. As an outgrowth of the recommendations that this Committee made, the Congress passed Public Law 159 on July 14, 1955. While the Congress was considering this legislation, the Public Health Service was fortunate in having Dr. Thomas Mancuso come with us for a brief time to make a study of the problem and to develop an outline for the future program activities on the medical side.

During this period we held a conference on the epidemiology of air pollution in May of 1955, and there was a tissue culture conference in June of 1955.

Following the passage of the law it was decided, on the medical side of the program, that the early approach should be to determine the toxicology of air pollutants that might exist in various communities around the Country. In line with this, several studies on toxicology have been developed. I believe that the first effort was made as a Direct Operation, when the air pollution program supplemented the activities of our Occupational Health Field Headquarters in Cincinnati. There for a year or more Dr. Stokinger has been studying the effects of air pollutants on small animals.

In addition to the Direct Operation at Cincinnati, we have developed contracts on the effects of air pollutants with Dr. Gast, a biochemist at Baylor University, and with Dr. Pace at the University of Nebraska, at Lincoln. At the present time we have additional contracts under consideration which will be duly approved in the near future.

The first efforts in this field have now about reached a plateau, that of developing studies in the toxicology field. From here on we hope to get into community studies. These community studies have already been considered to some extent. We have been interested in determining what tests can be used in a community to give some indication of the long-term effects -- or the short-term effects, for that matter -- of air pollutants on people. In line with that, a group of prominent pulmonary physiologists met with us in March of 1956 and made certain recommendations that we hope will be placed before this group.

Having the opinion of the pulmonary physiologists on the types and kinds of tests that may be available to us, we felt that we needed the advice and guidance of a group of individuals who were competent in the field of epidemiology and in the application of community studies. As a result, we have invited you here today to work with us and give us the benefit of your advice and to outline what you think would be feasible and practicable for us to do in communities to learn how air pollutants affect people, if, in fact, they do.

I might also mention that we have several mechanisms for getting our work and studies done. Public Law 159 is a very flexible document. It provides for research grants. These are handled through the regular Research Grants mechanism of the National Institutes of Health. We have very little control over them. The Law also permits us to carry out Direct Operations such as are being done at the Occupational Field Headquarters in Cincinnati. In addition to that, it permits us to negotiate contracts for research activities. We should like to limit our direct operations as much as possible. We prefer to carry on our activities through the research grants mechanism wherever it is practical or feasible; and, where we need to obtain certain information over which we want to maintain some direct control or guidance we need to use the contract method. By a contract I mean the mechanism whereby an individual or an institution contracts with the Public Health Service to do research of a certain type, using specifications which usually are quite broad.

DR. FISHER: I might comment on the publicity that Public Law 159 has received. In these two programs or in the combined program of the two Divisions, we have not expended or had available to us the $5 million a year, yet. The first year there was about $1.8 million available; this year something near $1 million more than that. We did not receive the full $5 million authorized in either year.

You have been provided with some documents. In order not to burden you with a lot of reading material that possibly you couldn't review before you got here, other materials were held up and are in the room for distribution, as you may wish them.

The air pollution problem is a joint operation between the Division of Engineering Services and Special Health Services, as you have heard. We are now, after a little more than a year, beginning to see a few things where we can help each other and to define our own future progress.

We have been limited by the fact that most of the background information on air pollution relates to industrial air pollution. Most of the research has been related to occupational health and industrial medicine. We have had a very cooperative group in occupational health working with us in the initiation and development of this program. Dr. Mancuso is probably the best example of the assistance we have gotten in that. He has made an outstanding contribution.

For consideration in community air pollution we have simply said that the fence around the plant is usually a cyclone wire fence and the air pollutants move through that cyclone fence readily. That relates to the point sources of air pollutants which may be specific and which may or may not be changed in the atmosphere. In addition, there are the more properly designated community air pollution problems, the "smogs" if you will - the piling up of each minute contribution by the family or the individual or social unit - helping to make the community unlivable. Material from incinerators, material from automobile exhausts, materials from a thousand and one things humans do, in dumping their refuse into the air, combine into a dynamic mixture which is very difficult to work with.

The hydrocarbon oxides of nitrogen series alone have been stated as giving rise to anywhere between 150 and 1000 compounds, some of a fairly permanent character: some have a lifetime of a few microseconds in the atmosphere. A very considerable amount of chemical study, identification and characterization, remains to be done.

We are dealing with a mixture which at the present time is difficult, and, in many cases, impossible to characterize. To that of course is added the mixtures from industry. Altogether these air effluents, some of them point source, some of them community types of pollutants, have produced damage to plants; they produce damage in animals; they will peel paint off houses. We believe, in view of the demonstrated damage to vegetation and physical structures, there must be some effect on the human which results from inhaling that material or from having the materials in contact with the skin.

In the early part of the program we considered the health effects as lying between the diaphragm and the glottis. That is where we are mostly interested now in our research programs. We have started the biological-clinical appraisal series of studies. We are now ready to move into the field of community studies. One of those is pretty far along. Some of you have met here before to consider one of the contracts which we shall hear about later.

There are no standards at present whereby air pollution in a city may be characterized and compared as differing from, or being similar to, air pollution in another community. Our first problem in any community study is comparing community types of air pollution.

Quite frankly at the present time we are not sure what we are looking for. It is something that is produced as the result of long-time exposure, 24-hours a day for 7 days a week, every week in the year the exposure being to substances which are not now known or recognized. That is a vicious circle. The Service engineering group says that it will start identifying these substances later as soon as we tell them what is toxic. We say we will do the toxicology as soon as they identify the substances. The circle goes round and round. There is a considerable amount of work being done around the Country. Some of it is in industry; some available to us and some not. Some of the material in the Army Chemical Corps has been available to us, and there is a considerable backlog of know-how and special studies in that group which will be pertinent.

While defining our problem and seeking a way to work, we have used advisory groups. We have as yet no permanent over-all advisory group on air pollution. Thus far we have worked with ad-hoc groups such as yourselves. Within a single discipline we try to get together between six and twelve people, get the general thinking from that group, and set up a series of small working committees to attack special problems. Eventually we must come back to a general committee. At the present time a general committee would contain about 22 specialists. We have not considered it feasible to work with that sized group as a general committee. We may end up with six or eight representatives, probably one or two from this group, one or two from the pulmonary physiology group, the toxicology group, and so on.

We have had one major problem in getting contracts and in getting interest aroused for research grants. It is difficult to convert an accomplished research man, a skilled investigator who is reasonably happy with what he is doing, and guide him into this "never-never land" of air pollution. One of our major problems is finding people who can be interested in air pollution as an investigative subject.

Now we shall very briefly give you the story of our financial management of the problem.

MR. HOLLINGSHEAD: The first matter I should like to clarify is the difference between the authorization of $5 million a year and the actual appropriation that the Service has received. It is quite customary in the Federal Government for authorizations not to be fully implemented by appropriations. However, there have been many stories in the newspapers which would lead one to believe that we actually had $25 million a year to work with. In fact, we have only an authorization of $5 million a year, for five fiscal years, which started with the last fiscal year. We are now in the second year of our five-year program.

The appropriation for the first two years, including the current year, totalled about $4.4 million, or about 44 percent of the $10 million authorized. In the next fiscal year, the one which will start next July 1st, we have great hopes of getting, for the first time, the full $5 million authorized.

The funds which are finally appropriated are allocated first, for environmental (engineering) activities, and, second, for medical studies. A third allocation is made for grants, which may be used for research grants, demonstration projects or for training activities. The funds allocated for grants are beyond the direct control of the operating program, but they are included in our budget.

Roughly 28 to 29 percent of the available funds this year, and the anticipated funds next year, are allocated to grants. Of the balance, about $2 out of every $3 is allocated for engineering and environmental studies, and bout $1 for medical studies. So we have about $650,000 available in fiscal 1957 for air pollution medical studies, which we can either do ourselves or contract with others to do. We expect approximately 1.3 million dollars next year, or virtually a doubling of our budget.

As to how we are spending the money which we have, we can say that in 1957 the emphasis is largely upon laboratory research studies, primarily in toxicology. Sixty-three per cent of our current funds are being spent, either by our program by contractors, or by other Federal agencies, on toxicologic projects, and about 31 per cent is being spent on epidemiologic studies. The balance of 6 per cent is for the technical assistance and direct training we are now doing.

For the next fiscal year the picture will change quite a bit. Our laboratory studies will require about 40 per cent of the total, as compared to 63 per cent this year, and our epidemiologic studies will increase to a total of 51 per cent.

DR. SMITH: Is that of the $1.3 million?

MR. HOLLINGSHEAD: That is right. The anticipated total available for epidemiologic studies will be on the order of $650,000.

We have tentatively divided our epidemiologic studies into two groups; those which we call,for budget purposes, "statistical epidemiology", which are studies that do not involve actual clinical measurement or appraisal of people, but would largely be conducted by analysis of data from such sources as vital statistics records and insurance companies, and those that do involve collection of clinical data.

Roughly 15 per cent of our total budget, or about one-third of the total epidemiologic budget, is for statistical studies, and about two-thirds is for clinical field investigations, which involve, in addition to statistical considerations, the use of physicians, either to examine people directly, or to cooperate through hospitals with other physicians who do have clinical facilities.

DR. FISHER: Mr. Mackenzie, have you any comment on this subject?

MR. MACKENZIE: No.

DR. FISHER: I will now call on Dr. Heimann, Chief, Operational Research of our Program, to outline for us present and proposed research projects in air pollution as a health problem.

DR. HEIMANN: May I refer you to the outline entitled, "Research Projects, Air Pollution Medical Program, Division of Special Health Services." (Pages 6 - 13 of the minutes.)

What we have here is a listing of the research projects that we have been thinking about seriously for some time or that we are actually engaged in at the present, in one way or another and in various degrees. I have listed here all the projects. We have also divided these into three groups: on page 7, the list epidemiologic studies begin. On page 10 the list of toxicologic studies begins. On page 13 I have a series of miscellaneous studies which were more difficult to classify.

These are the studies that we have considered that we were either financially able to get going or that were administratively feasible, or both. They are not listed in the order of their importance.

If you will refer to page 10, the toxicologic studies, I think that we can go through these rather rapidly. The first line in the column on the left indicates whether this is a contract or a research grant, or whatever mechanism is being used to get the job done. The second line in the column on the left indicates whether the project is actually in process or in the planning stage. The third line in that first column indicates who is doing the job for us. In some few instances we are doing it ourselves, and that is indicated. In column 2, you have a descriptive title, of the project. The last column is the identifying number for convenience of referral.

Item number 1 on page 10, "A" refers to the toxicity of organic peroxides, which is being done for us on experimental animals at the Occupational Health Field Headquarters in Cincinnati. The second refers to a study of the organic sulfides. These two, incidentally, are materials which have been identified as present, to a greater or lesser degree, in the air pollution of Los Angeles.

The next one, "C", is a study of chemical analytical procedures needed in the associated toxicologic studies of air pollutants. The Occupational Health Field Headquarters staff has indicated that it needs to develop chemical methods to be able to tell how much of a toxic substance is present at any moment of time.

The next two, "D" and "E", toxicological study of air pollutants and toxicologic screening of air pollutants, are about the same. These will be done to some degree in duplicate by two different groups. "D" is being done by the Division of Occupational Health at its Field Headquarters in Cincinnati, and "E" is to be done at Miami University. In some instances they will be examining the same substances.

Item "F", toxicologic study of air pollutants which is being done at the University of Southern California on synthetic air pollutants of the Los Angeles type.

"G" describes method development. This is one of the subjects that was discussed earlier by both Dr. Fisher and Dr. Osborne when they mentioned the need for us to know how to determine whether or not the materials are causing disease in humans. The first one of this group, "G, I," is being done at Baylor University by Dr. Gast in the Department of Biochemistry. He has under study the effect of air pollutants on animal enzyme systems, the uptake by red blood cells of oxygen, and the metabolism of white blood cells, among other studies. The purpose of his work is to develop methods so that we may know where to look in humans for disease effects.

The second item in this group involves a study of the effect of air pollutants upon animal tissue cultures. We were very fortunate in getting the Institute of Tissue Culture Studies of the University of Nebraska to beome interested in this problem. They are studying the effects of various known and suspected air pollutants upon growing tissue cultures by studying, both physiologic and anatomical changes.

The next item, III, involves a study of the effect of air pollutants upon plant tissues. This, we think, may again give us leads toward where to look in humans. This is being done at the University of California at Los Angeles by Dr. Bobrov of the Air Pollution Control District.

Finally, in that series we have a study of the effect of air pollutants upon animal tissue cultures as modified by influenza virus. It is being done in Los Angeles by Dr. Quilligan of the College of Medical Evangelists.

Continuing with the toxicologic studies, the next group are those specified as to disease or organ system involved. The first organ system discussed is the respiratory tract, and the second, the eyes.

For the respiratory tract involvement we are interested in the toxicity and mode of action of the oxides of nitrogen, item "2, A, I". This study is in progress at the Occupational Health Field Headquarters in Cincinnati. The same is true in regard to ozone, the next item.

Item "2, A, III" involves the toxicity and the mode of action of the oxides of sulfur, SO_2 and SO_3, and is being done by Dr. Amdur at the Harvard School of Public Health.

Item "2, A, IV" refers to the relationship of air pollution to lung infection, being done by Dr. Bryan at the University of California at Los Angeles. His study hopes to answer the question: "Does air pollution cause the lungs to be more susceptible to bacterial infection?"

The next one is the relation of air pollution to lung function changes. This relates to a specific type of air pollution, soft coal smoke, as it occurs at Nashville, Tennessee. This study at Nashville will be done by the Vanderbilt University Medical School group.

Item "2, A, VI", being worked on by Mr. Hatch at the University of Pittsburgh, involves a study of the differential in lung function effects of lung irritants. Next, is a study of the mechanism of lung parenchymal effects which is similar to Mr. Hatch's study and is being done by our Occupational Health Field Headquarters.

Item "2, A, VII" is a study of the metaplastic changes of the epithelium of the tracheobronchial tree which may be due to air pollution. This is being planned with the Armed Forces Institute of Pathology.

The next item is a study of the carcinogenicity of air pollutants, being done at the University of Southern California by Kotin and his group.

Item "IX" is the influence of weather upon aeroallergens which is being done at the University of Michigan. This includes the effects upon the human. The last project in this listing, a study of the effects on the eyes, which is in process at the University of California Medical School at San Francisco, involves the action of air pollutants upon the eyes.

DR. SMITH: On page 10 where you describe these studies that are being done on pollutants at Miami University, Baylor, and Nebraska, what types of pollutants are they using?

DR. FISHER: Hydrocarbon, NO_2, ultraviolet.

DR. SMITH: The Los Angeles material?

DR. FISHER: Yes, and some components therefrom.

DR. HEIMANN: If you will please refer to the next page, "miscellaneous studies", you will undoubtedly observe some overlapping. Please try to disregard it for the moment.

Item "1, A" is the development of air pollution indexes. Here our big problem is to determine how to compare communities by kinds and degrees of air pollution. The problem is how to develop an air pollution index. The obvious way is to make a lot of measurements in very community over the Country; but that would be an impossible task and from which we can't expect answers for at least five to ten years. We urgently need to develop some type of index which we may use for comparing the communities now. In connection with that we have the problem of the patterns of population migration. Since we are concerned with the people in these communities and their exposure to air pollution, we need to know something more than we now know about the movement of people away from one community to another where the pollution might be of a higher or lesser degree.

The next series refers to literature reviews. The first one is a review of all literature pertaining to air pollution effects on man, and is being done through Dr. Phair at the University of Cincinnati.

Item "2, B" is a current annotated bibliography on all aspects of air pollution. This includes engineering aspects. This is a current bibliography and comes to us periodically.

Finally, we have prepared the literature on the toxicology of fluorine compounds, in anticipation that we may be asked to study the effects of inhaled fluorine compounds on people in the communities.

I have left the epidemiologic studies for last for obvious reasons; that is mostly why we are here. But, first I wanted to give you the background of all the things we are doing. Now if we may go on to epidemiologic studies.

DR. FISHER: May I add one study? Under the effects on the eyes, in Los Angeles there is an additional study by Merrifield on the effect of the Los Angeles air pollutants on the eye. That was originally titled as the psychology of smog, a study of the community air pollutants as they exist in Los Angeles. Merrifield is a psychologist by background. It is a research grant in progress at the University of Southern California.

DR. HEIMANN: I have divided the epidemiologic studies into those not specified as to disease or organ system involved and, those specified as to disease or organ system involved. In the first group, for those in which we don't specify the organ system involved, there are general studies and possibly some that are more specific. Under general studies we have, first, the studies of mortality patterns. This obviously is a very broad grouping. In our Program Operations we are planning to do intra-city comparisons, possibly by using census tracts, of mortality patterns correlated with air pollution indexes.

The second study is also being done as a Program Operation, involving the inter-city comparisons of Old-Age and Survivors' Insurance Benefits data from the Social Security Administration. Possibly Mr. Manos, our Chief Statistician, may have something more to say about that later on today. The next study involves inter-city, utban, suburban, rural comparisons of mortality patterns with air pollution indexes. Finally, in that group we find we need information about the socio-economic status as it may affect mortality patterns in such groups. I am informed by our statistician that such information is needed in connection with our work. So we need to have that done by our own statistical group.

The next series involves studies of morbidity patterns. The first one listed is being done by the Detroit City Health Department through Dr. Molner. It concerns intra-city comparisons, with correlations against air pollution indexes. Dr. Wentworth may be able to say something about that. He has been concerned with some of those data.

The next item may be somewhat cryptic in its wording: "the effect of a 'prime' industrial contributor to community air pollution upon morbidity and mortality pattern of the community". What we meant here specifically, and what we are actually doing, is studying the effect of a strike, in the steel industry. When an industry closes down in a community, how does that affect the morbidity and mortality pattern of that community? The corollary of that is obvious that when the plant closes and the morbidity or mortality pattern becomes different, the plant probably had some relationship to this difference. This is being done as a Program Operation.

Item "II, C" is "inter-community comparison of morbidity with correlations against air pollution indexes". In this we are interested in, and will be working with, the plan that Dr. Perrott has of doing a large national morbidity survey on a continuing basis.

The intra-city comparison by place of residence with correlations against air pollution indexes is being done in the Los Angeles area through Dr. Breslow.

Item "II, E" is, "morbidity patterns in single-industry communities". This is a concept which we think is very important and we hope that possibly Dr. Kleinfeld may be able to give us some ideas about it. That is in the planning stage.

The next one is, "the sequelae of an acute episode of non-specific air pollution of an irritant nature some eight years after the episode". The contract is being worked on right now, but I have said here that the work is in process because I know that Dr. Ciocco and his group have actually been working on this over the past few months.

Then we have the group in which we specify the disease or organ system involved. Here we have the cardio-respiratory system effects. The first group involves lung cancer. The first item is "correlation of histologic type of lung cancer with air pollution indexes". This is in the planning stage with the Armed Forces Institute of Pathology.

The next one is "the relationship of current cancer mortality to air pollution indexes". We are working together with the National Cancer Institute in developing this project.

The next one is, "the significance of the Country of origin in lung cancer frequency". Dr. Mancuso and others have pointed out the necessity of having information on the Country of origin of people in relation to the occurrence of cancers of various sites.

Finally, in that group we have, "metaplastic changes of the tracheobronchial epthelium and its relationship to bronchial cancer correlated against air pollution indexes". This is by the Armed Forces Institute of Pathology.

In regard to chronic lung diseases other than cancer, the first is, "the correlation of incidence of non-tuberculous chronic lung disease against air pollution indexes", which will be done on Veterans Administration data.

Next is, "the relation of fluctuant levels of air pollution in a highly polluted community to exacerbations of chronic lung diseases"; for example, bronchial asthma.

"The relationship of non-specific chemical irritant air pollution to 'Yokohama asthma'". To some of you that may be a new term. It was discovered by the Army of Occupation that there was a series of cases in and around Yokohama, Japan where people developed asthma which was shown, to a degree, to be related to chemical air pollutants. It seemed that when they took these people out of the community, or left them in the community and had them breathe air which was filtered, they didn't have attacks, and when they got into the chemical irritant air pollution they developed attacks.

On the next page, page "9", is "the influence of fluctuant levels of air pollution upon the clinical course of persons with functional impairment of the cardio-respiratory system". This is being done through Dr. Phair at the University of Cincinnati.

"The influence of fluctuant levels of air pollution upon pulmonary function measured by a standard test", in both "normal" people and those with functional impairment of the Cardio-respiratory system. This is being done by Dr. Motley in Los Angeles.

The next one is, "the influence of air pollution upon pulmonary function measured by a standard test in large population groups". This is the one that was mentioned by Dr. Osborne for which we are interested in getting a standard, simplified test which can be used on large numbers of persons. By large numbers we mean about 5,000 to 20,000, distributed over some areas of the country where we can use this test to determine the influence of varying degrees of air pollution upon changes that might occur in pulmonary function.

The next one is, "the study of the course of heart diseases as influenced by air pollution indexes". Here we have in mind that the cardio-respiratory system is a single unit, and what affects the lungs will affect the heart, indirectly and possibly secondarily, but, in an important way.

"The significance of air pollution in the induction of morphologic, genetic, or physiologic changes of the bacterial flora of the upper respiratory tract". You notice we say the upper respiratory tract. We are informed that we are not to concern ourselves in our program with infectious organisms, but infections themselves. So we are limiting ourselves to the human body and planning that we may study those organisms which are present on the human or in the human. We will not study air bacteriology.

The effects of airborne fluoride salts upon man is being done by Dr. Greenwood at Utah State Agricultural College at Provo, Utah. He has been interested in the effects of fluorides on man and animals for a long time, and he is now engaged in a continuing study of this on humans.

DR. DUBLIN: Will you clarify something for me which may be purely language. In discussing the significance of air pollution you confused me a little bit by your choice of words. What was it that you said about bacterial studies?

DR. FISHER: May I reword that. That reflects the division of responsibility between the Communicable Disease Center and the Division of Special Health Services Air Pollution Program. Their fence encloses the effects of airborne infectious agents. Airborne infectious agents are the property of the Communicable Disease Center from the time they are coughed out until they get back in the body. We study the effects of air pollution on the organisms as organisms, as model systems for enzymes and hormones, and we are at liberty to get into the infected individual and follow the course of his infection. But what air pollution does to the bacteria in the air is the business of the Communicable Disease Center.

DR. DUBLIN: I think there ought to be some clarification of that issue. When you bring in a group of outsiders to discuss with you the problems of air pollution, and it becomes their considered judgment that these infectious agents might be in the atmosphere as a result of a component of air pollution and deserve study, I think that we are confusing the question of operational jurisdiction with a scientific issue. We ought to make clear to the Committee, if it is possible, that they are free to recommend studies or consider the advisability of studies in whatever areas their judgment leads them, without reference to administrative patterns of operation in any particular organization. That becomes a problem for the organization to work out subsequently; but I don't think that you should handicap their thinking.

DR. HEIMANN: What you say is very true, Tom. What we are hoping is that the group will give us its best advice on chemical air pollutants and their effect. We want to avoid a discussion of the effects of the pollutants on bacteria in the air, because this would occupy too much time and will be outside our immediate interests in this meeting.

DR. DUBLIN: I think it is clearer to me now than it was before.

DR. FISHER: Because of the way our budgets are set out and the funds available for research are distributed, we have in our program the ultimate demand to investigate the problems of air pollution as they relate to health, concerning ourselves primarily with chemical air pollutants. Certainly other types of air pollution and infectious agents or air pollutants are a matter for your consideration; but, our immediate responsibility and goal are to attack the problem of chemical air pollutants. For that reason we prefer that the time we have today be spent in that consideration. If there is information on infectious agents which would be pertinent by way of example we certainly would not rule it out. We need all the information we can get. It is simply that we are discussing the expenditure of funds on the chemical type of pollutants and their effects on the human and to a limited extent on the animal.

DR. SMITH: Dr. Fisher, just one thing which may escape me if I don't bring it up now. In this very admirable buildup to the use of the full $5 million, which is most gratifying to hear because of the need and the researchers who are available for it, there is a proportionate doubling as far as the activities in the Bureau of State Services is concerned. Does that also mean that there is a proportionate doubling as far as research grants are concerned?

MR. HOLLINGSHEAD: No, sir; it doesn't. So far as grants themselves are concerned, the percentage would remain just about the same, 29 per cent for one year and 28 per cent for the next, but the research grants are still only a part of the total grants budget, and most of the increase in grants will be for demonstration projects to assist States and cities on various aspects of air pollution, rather than research grants per se. The increase in research grants alone is estimated at about one-third.

DR. FISHER: Do you want to speak to that, Mr. MacKenzie?

MR. MACKENZIE: I think he answered it adequately, unless further information is desired.

DR. FISHER: May I remind you that our agenda today is in two parts, the first (page 1) which is in condensed form and the second (pages 2-4), which is in the form of a "discussion outline".

Dr. Ciocco, would you mind starting the discussion and give us some idea of what you conceive as the community problem in air pollution, specifically as regards your study?

DR. CIOCCO: As you know, in 1948 there was an acute episode of something in Donora in relation to a smog episode. The Public Health Service made observations regarding sickness of a sample of the population, approximately a third. The Public Health Service and ourselves, together, have considered the possibility of a follow-up of this population. Our first objective will be to contrast the health status during the past eight years of the groups of persons who were, according to their own statements, adversely affected with that of the persons who were not affected at the time of the episode. Our basic data will be the records which the Public Health Service has and which we will be able to utilize.

We want to compare differences in mortality and amount of morbidity in the groups in three ways: through hospitalization records, through physicians' records, and through the statements of the persons themselves. We also want to get a picture of symptoms and complaints that they may have now.

In addition to this principal objective we would like to get certain kinds of information on a sample of the population as a whole. One of the objectives, of this study, as we have discussed, is to have a base population that we, perhaps, can study in other ways in the future when we can obtain better methods for observation of pollution in the community.

From the mechanical standpoint our main problem will be the follow-up of individuals who were present in Donora in 1948 and who were seen by the Public Health interviewers. We hope to make this as complete as possible, and our main efforts will be in that direction.

DR. FISHER: Dr. Breslow, would you tell us about the California study?

DR. BRESLOW: In the California State Department of Public Health studies, we have divided our efforts into two major segments. One is concerned with the acute effects, and the other the long-term effects of air pollution.

In studying the acute effects we have taken a look at the mortality particularly of older persons living in Los Angeles - their total mortality and their mortality from selected causes that might be especially influenced by air pollution. We have examined this mortality in relation to the episodes of air pollution specified from environmental data.

Dr. Mills from Cincinnati has visited California from time to time and announced that there are excessive deaths in Los Angeles residents during and immediately after episodes of air pollution. We have also been looking at the data bearing on this question. We have kept under particular observation for the past two years a group of about 4000 older individuals living in nursing homes. These are, for the most part, quite frail, elderly people, averaging more than 75 years of age.

In none of these mortality studies have we been able to conclude any effect from air pollution, although the nursing home population has shown an almost 10-fold rise in mortality during periods of excessive heat in Los Angeles. It is, thus, quite a sensitive population, we believe.

In the acute-effects phase of our studies we have also observed morbidity. During the fall of 1954 we conducted a state-wide health survey, similar to that which is to be carried out Nationally. This included an attempt to determine whether there was any effect on the frequency of certain kinds of illness from the episodes of air pollution which during the 1954 fall months were quite pronounced. We observed by this method of study no increase in frequency of illness, even of the most minor sort. There was some greater attribution of the illness to air pollution, - illness at other times attributed to different factors - but no greater amount of illness itself.

Our acute-phase studies have also included observation of certain industrial populations to see whether there is a greater frequency of absenteeism and of attendance at industrial medical and nursing services during episodes of air pollution. There has been some indication that people actually do go to industrial nursing services for attention more frequently during these periods; but no influence that we have been able to determine upon absenteeism has been noted.

As to chronic and long-term effects the situation is a little more difficult. At the present time we are trying to determine whether exposure to the Los Angeles type of "smog" over many years induces a higher mortality from lung cancer, than occurs in persons who are exposed to it for lesser periods of time.

In air pollution studies in the whole Country we face the problem of migration. The intensity of this problem is much greater in California, and within California it is greater in Los Angeles. Hence such studies require careful attention to residence history.

With the support of a grant from the American Cancer Society, at the present time we are getting the residence history on sizable numbers of people, into the tens of thousands throughout the State, and particularly in Los Angeles. We divide these into groups of persons exposed for ten years and longer to Los Angeles "smog", persons exposed for lesser amounts of time in Los Angeles, and persons living elsewhere in the State. These persons will then be followed for several years through our mortality register to determine whether or not residence in Los Angeles influences mortality from lung cancer and, possibly, also mortality from other causes.

Secondly, as a means of getting at long-term morbidity from air pollution, we have selected from the state-wide health survey persons who were reported to have bronchitis, and certain other conditions, that might be influenced by air pollution. We hope to obtain assistance from the Public Health Service in establishing a follow-up system to determine whether the course of the illness in these persons is influenced by exposure to Los Angeles air pollution.

In addition to the California Health Survey of 1954-55, we have been engaged, the past few months, in another population survey with special attention to air pollution. This time emphasis is placed upon information as to symptoms that might be attributed to air pollution as well as to recognized diseases and, furthermore, attention is given to the influence of air pollution upon the way in which people live. There is considerable discussion in California as to whether people change their residence, change their jobs, and their recreational plans because of air pollution. A broad definition of health brings such matters within the sphere of interest. So we have endeavored to study through a household interview investigation whether or not people really are moving, or plan to move, and the extent to which they attribute such moves or plans to move to air pollution. There are other items in this study as well.

We have supported to a limited extent some research outside the Department; for example, the Merrifield study which we supported in the developmental period. Merrifield is a psychologist who is attempting to ascertain quantitatively the extent of eye irritation and its relationship to air pollution. Also we aided the work of Dr. Motley, who is developing methods to measure pulmonary function changes during episodes of air pollution and how this is affected by removing persons from the ambient air and placing them in air-filtered rooms. As yet no positive results have come from Dr. Motley's investigation, except that he is satisfied he has an adequate method now to carry out pulmonary function studies on limited numbers of persons.

DR. HEIMANN: May I make a comment for some of you to whom this problem of air pollution may be relatively new. In regard to what Dr. Breslow has said, would you keep in mind that in the case of Los Angeles smog we have a tremendous amount of data of what is in the air. True, there are differences of opinion as to which of this mass of substances is causing the trouble; but, still there is a sizable amount of information. This is not true for the rest of the Country where we know very little about what is in the air. This is a distinction I wish you would keep in mind because it is one of our large problems.

DR. FISHER: Dr. Kleinfeld, could you give us a brief report on your thoughts in New York?

DR. KLEINFELD: My Division, which includes Dr. Tabershaw, Mr. Baliff, and others, has evaluated problems of air pollution on many fronts. Dr. Heimann mentioned studying single industries as one approach that interests us. I will go into that approach further if it is desired.

As Dr. Breslow stated, the real problem in air pollution is the effect on chronic disease or the initiation of chronic disease. Our main concern has been with the effect of minute quantities of material over extended periods of time which produce altered metabolism not only in the lungs, but diffusely in many organs.

There seems to be sufficient data from food toxicologists to indicate that a number of trace metals may initiate chronic disease. The people who deal with food adulteration are concerned with the inclusion of minute amounts of adulterants because of the fear that they may produce cancer or other diseases. If their fears regarding minute quantities of food adulterants are justified, certainly atmospheric pollutants could reach us in far greater concentrations. Analyses, principally spectrographic analyses, have been done on autopsy material which show that a member of trace metals may be present frequently enough in sufficient concentration to be significant.

I noticed that a great number of these research grants are concerned with the effects of pollutants on tissue enzymes. The study at Baylor University is being focused on the inhibition of enzyme systems by pollutants, not necessarily metals. It is precisely on enzymes, themselves present in such small quantities, where minute amounts of toxic materials might be expected to produce a long-term effect.

If the spectrographic analyses on autopsy material are any indication, then one would be concerned about such materials as chromium, vanadium, cadmium, and son on. One would be concerned with their affinities for many organs such as the kidneys, liver, and pancreas, and not merely the lung. There is ample evidence that lead and mercury, for example, while absorbed chiefly by the lungs in industrial poisoning have their principal effects on distant organs. Therefore, I think studies should be pursued of many organs and systems and not only the pulmonary or cardio-vascular systems.

These considerations have lead us to be concerned with the possible effect of minute quantities on the initiation of disease. I mean a small fraction of the amount currently allowable for a single day, and absorbed over a long period of time. The effect might be on the course of diseases of known etiology or on diseases presently of unknown etiology, which are now simply characterized as syndromes.

We would like to see this problem pursued on three broad epidemiological fronts:

One, to select a stable population for which adequate vital statistics are available and analyse these statistics for morbidity and mortality rates for a variety of diseases. We would prefer to obtain a detailed environmental, including industrial, background for these individuals. We are also desirous of studying the atmosphere at frequent intervals for several of the known pollutants. The correlation of such data would, perhaps, give us an accurate picture of events in at least one defined segment of the problem which incomplete data on larger groups cannot give.

The second broad epidemiological front is the study of a population exposed to contaminants known to produce disease, for example, pneumoconiosis. In the Western part of New York State where we studied talc, as Dr. Heimann may recall, there was a high incidence of pulmonary fibrosis associated with exposure to talc in industry. The talc mills were in small villages. We are interested in knowing the effect of the talc which reaches the general atmosphere, that is the effect on the general population from this minimal exposure over an extended period, even longer than the 10, 15 or 20 years which may be required to produce the industrial disease. Other agents known to produce pulmonary fibrosis are beryllium, asbestos, and perhaps mica. A study on the effects of minimal exposure to pneumonconiotic agents is particularly significant in the light of the increasing number of cases of diffuse pulmonary fibrosis of unknown etiology.

This brings me to the third broad front, namely the epidemiological study of diseases of unknown etiology. Pulmonary emphysema, bronchogenic carcinoma and others might be studied in this way. We have selected Sarcoidosis because we know that at least one agent, beryllium, can produce a clinical and pathological picture indistinguishable from Sarcoid. The syndrome labelled, Sarcoid, might be produced by the body's reaction to a variety of agents; beryllium is known to be such an agent. There is evidence to suggest that soil of a particular area may be another. It has also been suggested that some chemical from pine trees may be a factor. We, of course, are particularly interested in the industrial pollutants which may produce the Sarcoid-like picture. We presently have trained personnel who are studying a large group of people with Sarcoid, stressing the industrial and environmental history of these people. We hope to clarify if possible, the environmental influences to which these people, or subgroups of these people, have been exposed. Individual case studies have given impetus to this approach. A case was recently reported of a woman who died of diffuse pulmonary fibrosis of unknown etiology. Silica, asbestos and other known agents had been excluded, but she had been exposed to bakelite in an extrusion process 15 years before. Birefringent crystals were found in her lung at autopsy. Analysis of the bakelite to which she had been exposed revealed a similar birefringency. We had known that bakelite can produce upper respiratory irritation, but this was the first clue that it may produce diffuse pulmonary fibrosis after prolonged exposure and after a lag period of 15 years. Such a case would have been called diffuse fibrosis of unknown etiology.

We like to emphasize the value of environmental and epidemiological studies of individual cases labelled as diseases of unknown etiology. The study of small groups of people with such diseases, and of selected groups of people exposed to a limited number of contaminants may have great value. We are looking forward to these studies in the hope of elucidating the epidemiologic and etiologic factors responsible for diseases associated with air pollution.

DR. FISHER: Dr. Wentworth, would you be in position to tell us what happened when the first tests of the experience of people living in dirty versus non-dirty parts of the City of Detroit showed up? Dr. Wentworth was involved in the Detroit study of air pollution.

DR. WENTWORTH: I don't think that I am in a position to bring before this group the results of that work. As you know, I was not in on the study; but Dr. Fay Hemphill and I have been looking at the data collected over a 3-year period. A great many difficulties faced that study group. One has been touched upon here already, namely, the problem of the selection of a proper index of pollution, and, secondly, and perhaps more important, the problem of the collection of morbidity data over a long period of time with inadequately trained personnel.

I think there is real doubt at this time as to what meaningful data have come out of that study, but I don't think it would be fair for me, without representation from the Detroit study group, to state any personal conclusions about it. I think many of you have had a look at the study from time to time. Its general plan was adequate, but the operation of the study had many faults which ought to be reviewed at more length but not now.

DR. FISHER: We would be very happy if you could comment during the day on what you found while going through that data.

DR. WENTWORTH: In discussing methodology one assumes well trained people, adequate, full-time supervision and sufficient funds to hire the necessary technical personnel. These were absent. So the methodology as applied to Detroit was not optimal and the discussion of it as it was carried out would not be very helpful, to this group. You are familiar already with the over-all plan of the study which I believe was quite adequate. The problem mainly has been in the operation. It wasn't successful because of the absence of the necessary ingredients of such a study -- supervision and well-trained help.

DR. SMITH: Could I ask one question: Having been involved in the discussion of whether or not the Detroit study should go into operation, were they not depending upon a daily diary being kept by the individuals?

DR. WENTWORTH: Partially correct. They were depending on the so-called health calendar approach which has been used in other studies.

DR. SMITH: It seems to me that this is a very important consideration for us because this is one possible method. Breslow's California studies were on the sampling interview method, and so are Dr. Ciocco's. I think this is one of the really important points that we ought to be considering in the future studies. Could you say anything, then, with respect to the daily diary, or calendar approach, as compared to the interview approach?

DR. WENTWORTH: This study actually combined the two. It depended mainly on individual interviews at 2-week intervals. The population to be studied was also requested to keep a brief calendar which would delineate illnesses, the dates of onset, the days of duration, and the date the patient was well. No comparison of these methods can be made because they were trying to integrate the two methods together to begin with, and secondly, the health calendar part of it just didn't work out. So many of the interview personnel were unable to get the families to cooperate and keep the calendar properly. We know from other studies that such calendars can be kept properly. I think Dr. Hemphill demonstrated that with the home accident study at Ann Arbor reasonably well. It probably can be used.

DR. HEIMANN: We are still trying to get help. As Dr. Smith said, this is one approach and may be the one that should be considered in order to collect our epidemiological data. Your experience is that it didn't work there, but you feel that it could work if it were done at greater cost and with greater precautions than possibly was done there.

I would like to introduce next Mr. Manos from our Statistical Group.

MR. MANOS: I would like to make one point on the question of the Detroit study. This brings up clearly one problem which we face continually, and that is how do we apportion our money and efforts between intensive and exploratory studies. It isn't immediately obvious, that, if you had put more money, time, and effort into a study like that, that it would be better. I am just asking that as a question that we would like advice on.

One study that we started on very early was to decide what we are to use as a measure of air pollution. We must have some way of breaking into this vicious circle that Dr. Fisher and Dr. Heimann mentioned, and that is that if you don't know what is doing harm, you don't know what to measure. One way to break into it is to try to work up an index of air pollution, non-specific air pollution, and perhaps later to try to define it and go into the specific elements of that pollution. We can use such indexes to correlate with health measurements which we will get later, and we can use them to help us select the community to study. I would like to have Mrs. Fisher, who has been working on this, give you a little more on just what we have done.

MRS. FISHER: We have air sample results in some 60 cities as an index for air pollution in the measures of total particulate and particulate organic matter. We intend to use these in comparing them with the morbidity and mortality data of those cities. But there are some shortcomings in these data in reference to our special problem. One of those is that we have them only for those areas. Another one is that we feel it does not give a complete characterization of the air pollution in the area.

There are a lot of other factors involved in air pollution build-up that we have to consider. These are, for example, the weather, the topography of the area, the amount and kind of industry in the area, the number of automobiles in use, incinerators, and heating plants. All of these things may influence how this air pollution is affecting the population.

We are in process now of developing an index which we hope eventually will include most of these factors. We will have to start with single factors and relate them to morbidity and mortality. Once we know whether or not they have a direct or indirect relationship we should be able to incorporate many of these more important factors in the index. We are now in process of developing an industrial index and a weather index. We hope that when we have these indexes we will be able to relate them to any specific area.

MR. MANOS: Thank you.

What health data do we have that we can correlate with thisindex? Our first source, which is nation-wide, is the data on mortality which have been tabulated for us at the National Institute of Health, giving us mortality data in greater detail than it ever has been available before. We have the mortality data by county, and within each county it is broken down under causes of death and the rest of the details, that is, by age groups, sex, and race.

Another source of data which we considered for research was that for veterans with disability. This would give us a large group of people whom we could follow up and on whom records are available. We have been talking with Mr. Jablon of the National Research Council who could undertake such a study for us. Another possibility is that we,as part of our operations, could do small exploratory studies directly with data that we can get from veterans' folders. If we get enough clues to set up a larger study we could contract to have it done. We could have an organization like the National Research Council do it for us.

DR. CIOCCO: You mentioned the index. Just what is it?

MR. MANOS: We had to start some place, and the place we started was this: Let us start out by taking the 169 categories of industries and ranking those industries, giving them to a person who has some opinion as to what the most suspect industries are, ranking those in order in terms of pollution and in terms of potential effects on health.

DR. HEIMANN: In the first place, somewhere along in the early part of Manos' discussion he mentioned non-specific pollution. This refers to non-specific pollution that irritates the exposed mucous membrane.

Going on from that, we say -- and this is supposition -- air pollution in places like New York, Chicago, Indianapolis, and other cities, is similar in that each has materials which irritate exposed mucous membranes. We will set up an index of the degree to which such irritants are present. We feel that first we will need to set up an industrial index. We have attempted to classify the industries by the three-digit industrial code classification,by their potential ability to produce air pollution of a non-specific nature, and potential also in terms of their possibility of causing irritation of exposed mucous membrances. So it is a combination of amount plus toxicity.

This is the first step in developing an air pollution index. We don't know how far we will get, but we think it is necessary, first, to give an order of magnitude. Take, for example, a community that has 5000 persons employed in the sewing of garments. If you were going to take, in such an instance, only the numbers of persons employed in that community as an index of air pollution, we think that that would not work out. Because from our experience in occupational health we know that the potential air pollutants that would be discharged into the air of the community from such a plant would be of no consequence at all. Whereas, a plant such as a foundry that was employing only 20 persons, compared to the other employing 5000, would be of much greater importance in terms of the pollutants it throws out into the air. We wonder how far we will get with this.

DR. CIOCCO: Somebody has to start.

DR. DAVID: Have you considered the possibility of regional differences?

DR. HEIMANN: That matter was brought to our attention very early in the development of this concept. Mr. Stern of the Engineering group informed us that air pollution from a given type of industrial plant in one community will be different from another area. He pointed out that the West Coast air pollution would be grossly different from East Coast air pollution. So, we are getting many opinions about classifying the industrial plants. We are getting opinions from the West Coast on this matter and will integrate them.

MR. MANOS: May I put it specifically this way: For the 169 large metropolitan areas in this country we will have mortality data in great detail. So for those same cities, we would like to develop this index, using this ranking of industries, which is done subjectively. We have the number of employees of each industry in each city. Then we need some weighting to combine these. This is the first approximation. We combine these and see how it correlates with mortality. Perhaps the correlation itself could give us some idea of the relative weighting if we want to see which factor of the index is perhaps the most important one to look at.

DR. FISHER: As has been said, there is no way to go back to 1930, 1940, 1950, and define air pollution as it existed in these metropolitan areas for those years. There are some very crude data. In some places there is an intensive study of dust fall, or soot fall, and quite often there is none. The network sampling system which you have heard about has data only since 1948. Its collections will be useful from now on, in part. As the program develops, as the analyses of their collections is helpful, we may be able to tie the data back to our index which we are forced to use for the preceding decades.

Implicit in all this is the fact that we believe we must relate length of residence to these pollution levels; we must show long residence time under conditions such as may be described in the index.

Dr. David Price, Assistant Surgeon General, just came into the room. Dr. Price.

DR. PRICE: I just came to shake hands, and see some of my old friends here. I wish I could stay with you and find out what you all think about this tough problem.

... The meeting adjourned at 12 o'clock ...

FRIDAY AFTERNOON SESSION

The Conference reconvened at 1:00 p.m., Dr. Wilton M. Fisher presiding.

DR. FISHER: Dr. Jablon, do you want to tell us about your resources?

DR. JABLON: I would be very glad to talk about them a little bit. They are resources that we at the National Research Council have been trying to learn how to exploit in the last few years - the resources of the Veterans Administration.

I think we have satisfied ourselves that a great many useful things can be done with these resources. What I would like to do in a few minutes is to describe them, because it may be that they would be useful to you in solving some of the many problems which you have.

As you probably know, the Veterans Administration operates a very large hospital program and they also pay disability compensation pensions to a great many veterans of World Wars I and II. The thing which makes it possible to tap this system for information relatively easily is that most of the records which pertain to a given man rest in a single place, in a single folder. If, therefore, you know whom it is that you want to study, you can find in a single folder a complete record of all of the contacts which this veteran has had with the Veterans Administration, and this includes a residence history during the time in which he had been in contact with the VA, a complete list of hospital admissions with diagnoses, and so forth. Clinical records covering such hospital admissions can be obtained, although they are not present in those folders.

It is possible, through the mechanism of the VA system, combined with the resources of the statistical department of the Surgeon General's office of the Department of the Army, to do what one might call "prospective follow-up studies in restrospect". By this I mean defining a cohort at some previous point in time and, in effect, finding out what has happened to the cohort in the interim. That is not a retrospective study but a prospective study started at a prior date. For example, if one were interested in studying the varying course of bronchial asthma depending upon residence of men over a period of time, it would be possible to start on the records of the approximately 38,000 men who were medically discharged from the Army in World War II for bronchial asthma, and most of whom, I would guess, then began drawing disability compensation from the Veterans Administration for that cause; or , at least one might take that sub-section of the total group that began drawing medical disability from the VA, and then trace their histories from the year 1944 or 1945 to date; determine how many had died, what they had died of, how many Veterans Administration hospital admissions they had generated, what the diagnoses were, and so forth.

This is just a single example of the kind of study that can be done on VA recorded material which is available. I think it is something that might be thought about in an area which is as difficult to get started in as this one seems to be.

DR. FISHER: You have now heard some selective highlights and summaries of our backup material. I would like, if we may, to refer to the agenda, "II A, B, and C", and with respect to those three questions I am going to take the liberty and the chair's privilege of letting the people who have not spoken up thus far today speak their minds, if they wish.

Dr. Smith, would you mind giving us the benefit of any opinions you have on these points?

DR. SMITH: One point which we have to bear in mind, and which we in California find is especially important, is the fact that we really have two problems. One of them is the acute, so-called catastrophic, problem, and the second one is the long-range problem. Most of our discussions here have been on the long-range problem. That probably is where we are going to need to apply most of our attention. At the same time out in California we have a very serious matter. I don't know whether or not epidemiology is going to help us out, but we have certain standards as far as degrees of alarm. Five-tenths parts per million of oxidants is called an "alert", 1.0 parts per million brings in a crisis. At 1.5 parts per million of oxidants, which has fortunately never quite been reached, the Governor is supposed to declare a state of emergency, and then we don't know what happens at that stage.

In Breslow's studies in the nursing homes he was seeking an answer to the question of catastrophic damage. We don't know whether this is something that creeps up on us or whether suddenly we have a Donora on our hands. Dr. Ciocco is going back over Donora to see whether or not the catastrophic situation also carries with it implications of long-time effects. I think that is a very interesting approach. At the same time I would question whether a negative answer, as between those who were or were not affected adversely at that one episode, will necessarily imply that there are no long-term effects.

We have to separate sharply the epidemiological and physiological considerations on the two bases of the catastrophic crises and of the long-term effects.

DR. GAULD: Could I disagree with you?

DR. SMITH: Fine, Ross. That is just what I was waiting for.

DR. GAULD: It seems to me this is all part of the same picture. It is like trying to differentiate an epidemic of diphtheria from inter-epidemic diphtheria, sporadic diphtheria. I think you have to look at all of this at the same time. If you had the information during an epidemic period it would be very important, but it would have to be related to the inter-epidemic period. I don't see how you can avoid that.

DR. SMITH: Ross, to use your analogy of diphtheria, what I am trying to get at is, what is the relationship between deaths from diphtheria and deaths from cancer. The long-term effects may or may not, but I suspect would, have a different physiological basis than the things that cause a person to die quickly.

DR. GAULD: I would be inclined to think that one was an exacerbation of the other.

DR. HEIMANN: I must differ with you, Dr. Gauld, in this sense: The exposure to low concentrations of these materials over a long period of time may very well have no effect on health at all, because the body may be able to take care of these small doses. On the other hand, raising the exposure to a high enough level may become of physiologic significance. So the analogy with diphtheria of an inter-epidemic period and an epidemic period I do not believe will hold water in this case.

DR. GAULD: In diphtheria you have inapparent cases and apparent cases. In the long-term here, almost all your cases are inapparent. I think it is only during the acute episodes that you do get the apparent cases. That is your problem. One of your big difficulties is that you are dealing with a condition where 9,999 cases out of 10,000 are inapparent. They are not diagnosable. You can't pick them up.

DR. HEIMANN: I go a step further than that. I would like to use an analogy that was used by Dr. George Wright at one of our sessions. He said, if you hit a man on the head with a sledge hammer once he will die of a fractured skull; but, if you hit him with a pencil lightly for ten thousand times the sum total of that, even though of equal energy application to the skull, is not quite the same in terms of the effect as that of the sledge hammer, that is the difference between short-term exposures to high concentrations of these materials and the continued long-term exposure to low concentrations.

DR. SMITH: Could I put in another one. Analogies are very dangerous and I probably am wrong even to bring it up. But don't you think that there is a difference in the effect of acute alcoholism from which an individual may die, and the alcholoic who continues imbibing over a long period of time and who in one way or another has associated cirrhosis of the liver.

I will agree with you that we need to study it all, but there is one problem that worries us all in California and for which there is really no answer as yet: How high can these levels of pollutants rise before they begin killing somebody?

DR. GORDON: More is involved than the rise in total air pollutants. Which particular ones are increasing? Equal effect does not result from all.

DR. GAULD: I am not arguing that that is not an important part of it. What I am arguing is that they are all part of the same picture.

DR. FLORIO: One thing is clear, isn't it, that this may not be a health problem but people are certainly concerned about it. It is an esthetic problem. The problem of air pollution will have to be solved on this basis, even if it has no health implications. After you work for many years you may conclude that it has nothing to do with health or very little to do with it, except in special situations. We are still going to have to solve it, regardless of the rationale for doing so. It may not be a function of the U. S. Public Health Service, however, but the function of some other Department.

DR. DUBLIN: I think I would be inclined to take a little issue with Dr. Florio on that, since we are starting to take issue. Dr. Breslow commented this morning about the impact of an air pollution situation in a city on the migration of population and a lot of its habits. There was reference this morning to the psychological impact of air pollution on attitudes of people and Dr. Smith just pointed out that a state of emergency is determined by so much of an element in the atmosphere. It seems to me that those are just as much health problems as some alteration in tissue appearance under the microscope or in metabolic changes in the scales that we are traditionally accustomed to seeing. I think those are just as much health problems.

DR. FLORIO: Everything is a health problem. The crowing rooster that keeps you awake is a health problem if you want to define it that way.

DR. SMITH: This is not just your point of view, Tom, or yours, either, Lloyd. It is the point of view of the Legislature of the State of California which made the State Health Department responsible for sentinel activities and designated smog a health problem and put the responsibility in the hands of the California State Department of Public Health.

DR. FLORIO: I would say it is a good place to put it, but that doesn't make it a health problem.

DR. BRESLOW: We regard air pollution as a health problem for three reasons: first, because of its immediate and obvious interference with the well-being of people; second, because of the danger of disastrous consequences such as have occurred elsewhere in the world; and thirdly, because of the possible but as yet undetermined long-term effects. This does not say that air pollution has or will have any of the last two consequences involved, but it remains a health problem until we solve all of these three problems.

DR. GORDON: You put your long-term effects in terms of psyche as well as soma.

DR. BRESLOW: Yes.

DR. GORDON: Apropos of Dr. Dublin's comment, I might say that arctic cold as a function of environment may result in frozen feet or arctic melancholia. Both are distinct health problems.

DR. FLORIO: Everything is a health problem -- even the hole in the street, if you put your foot in it and break your leg; but, that doesn't mean we go out and repair the streets. I am perfectly willing to admit it is in the right place, certainly for the moment.

DR. FISHER: Dr. Smith, did I interpret a suggestion that we need some more physiological studies and information before we set about major epidemiological studies?

DR. SMITH: No. I think we can't wait for those, but I think there should be concurrent physiological studies that would be going on with the epidemiological studies.

For the purpose of speed, could I suggest as far as paragraph "A" is concerned, "Does long-term exposure to air pollutants of various types and amounts cause and/or modify human disease?", just say we don't know as yet, and that is what we have to try to find out. If anybody could answer that affirmatively might I suggest that you request him to speak up, and that will speed things up. I know that is one of your primary responsibilities.

DR. FISHER: Yes, sir.

DR. WENTWORTH: Dr. Fisher, you asked the question whether or not further physiologic studies were necessary, and Dr. Smith said, no, he didn't think we should wait.

DR. SMITH: Don't misunderstand me. I said we couldn't wait.

DR. WENTWORTH: And we have to go ahead with epidemiologic studies?

DR. SMITH: I think they should go on concurrently, but we should not defer our epidemiological studies until we have the physiological answers. Some of the clues which we shall be getting in our epidemiological studies may very well be passed over to physiologists to try to answer. We could draw various other analogies with infectious diseases, but I think that here we don't need to do that.

DR. WENTWORTH: On the other hand, without a little more definite information on one side of the fence or the other, is it not a little difficult to know what you are associating with what? You have to have enough to design the epidemiologic study in such a way that we can get information which will be meaningful and related to a definite pollutant in the air.

DR. SMITH: John, would you mention something about epidemiological design?

DR. GORDON: I remarked when we were gossiping at lunch that experimental design was an admirable part of methodology but to think that design is going to settle a problem is mistaken. The important thing in instance after instance is how well operational procedure meets the demands of that design, and change in design is frequently dictated by operational findings. Blind adherence to a fixed design may lead to no purposeful result or even discount all positive results. Operational efficiency and adapting a plan to what is found are important considerations in any field study. That, to me, is research. One turns this way or that way, and does not necessarily stick to a preconceived plan.

DR. SMITH: Apropos of your point and to illustrate what I was trying to indicate; Breslow is not waiting for more physiological studies before attempting his California epidemiological studies. There are already enough "hunches" which can be tested to make our epidemiological studies appropriate. Getting back to John Gordon's point again, it is important that in our design we not just hold to what we had initially intended to prove or disprove. In the course of the California studies which are being proposed we may well pick up a clue to a disease unrelated to carcinoma of the lung. The disease might be a toxicological problem in line with the New York point of view of deleterious systemic effect of minute amount of pollutants. Following up John Gordon's point, we should have sufficient alertness, and also flexibility, in methodology to be able to pursue such new leads appropriately.

DR. DUBLIN: Could I go back to the point that Les raised this morning just to make sure I understood the connotation? Les, in your presentation this morning you said you were studying a group of individuals in nursing homes, essentially a long-term follow-up of these individuals, as I gather it.

DR. BRESLOW: As long as they lived in the nursing homes. We are using them for a "biological alert system". Only people who have been in Los Angeles during one of these episodes and smelled the "smog" and read the newspapers can really be as sensitive to it as some of us are. When we get back here it sounds a little odd; but, if you have spent some days out there you realize the tremendous anxiety of people with regard to a repetition of the Donora experience. The environmental hygienists have set up chemical alert systems in which none of us, they or we or anybody else, has very great confidence. So we have set up this biological alert system among the nursing home patients. It is very simple. We collect from the nursing homes, on a daily basis, a report of the number of persons who die, and the number of persons who are transferred to hospitals. Then we study the variations in respect to ambient temperature and the various indexes of smog that are available. If anything drastic is to be done in Los Angeles it may wait until some effects are noted among these people in the biological alert system, rather than upon the occurrence of anything that can be noted chemically.

DR. DUBLIN: That is the inference I drew when you outlined it, and I thought it worth while to bring it back and emphasize it as an index of acute air pollution. It seems to me that until we are a lot further along in some of these, shall I say environmental indices, or physical indices, the biological indices may be very useful and, in fact, probably are much more sensitive as a measurement of problems than any others that have yet been conceived.

DR. SMITH: The reason for my having raised the point was to emphasize the fact that our outline did not include the acute problem. While I go along with what Ross has to say about all aspects having to be considered appropriate, nevertheless the hazard of catastrophe must be borne in mind. It differs significantly from the long-range problem to which our discussion is mainly and properly focused.

DR. DUBLIN: I think it was Harry who mentioned this morning that this part of the Service must be concerned not only with Los Angeles but with the National picture. It seems to me that an inference that might be drawn from this is; Is the methodology which has been developed in setting up this biological index of air pollution in Los Angeles something that might be duplicated or tried out elsewhere? Might there not be some interesting comparisons with comparable biological indices in other cities or other communities that would be worthy of study and exploration?

DR. FRYE: I think certainly some of the things that have to be developed are methods of determining what the effects are. We have talked about physiology and the physiological response. I would be interested to know whether or not we might consider along with these epidemiological studies and the physiological studies the importance of cellular changes. There are techniques and methods now available for the study, for example, of lung tissue with very small amounts of noxious agent which would be very valuable in setting up some sort of method of approach to this problem. I am thinking of a geographic study. The VA has many areas throughout the country where people are kept for years at a time and die.

Those lungs could be studied. We could have them from Los Angeles and other places and use some morphological technique to go along with the epidemiological and physiological studies. You know the techniques of electron microscopy which are available. I am thinking about a study that I am familiar with which started out to get the effect of viruses, for example, in lung tissue in mice. We got started on that a few years ago and found out that we didn't know anything about normal tissue as far as the electron microscopy is concerned. So here is a possible method of putting all of these together and coming up with the epidemiology, with the physiology, and with the morphology, a possible technique for determining the effect of small amounts of materials that you have mentioned.

So I put this in at this point as an over-all thought that can go along with the epidemiology, and with the physiology. These things might be specific. Tissues could be studied from humans along with data on possible air pollutants in clean, in moderately affected, and in other areas. I should think we ought to consider this, too, as a method.

DR. GILLIAM: I wonder if general mortality is all the elderly of the area might serve as a substitute for recording mortality in the nursing home. If you found in the Los Angeles area that the nursing home death index varied regularly with mortality in all elderly people in the area, then you could use the latter which is readily available from official agencies. This has the added advantage that such data, for comparative purposes, are available from all large metropolitan areas.

It gets back to the point which is in the minds of everybody, that the problems which appear peculiar to Los Angeles may not be solvable in Los Angeles alone but require similar observations from New Orleans or Washington for comparison. The National Office of Vital Statistics publishes weekly reports of all deaths from a selected group of large cities. If mortality in all elderly can be shown to serve the same purpose as mortality in your nursing home, it will be relatively simple to get such observations from as many large cities as you want. Of course, the deaths in a nursing home might not parallel those occurring in the general population of the elderly, but if they do, you have an inexpensive and practical index which is comparable in all large cities.

DR. BRESLOW: I would certainly concur that it would be useful, to do it around the country in several cities and possibly even in some rural areas, too, by way of contrast. From the standpoint of feasibility, in Los Angeles County the general mortality reporting system is quite difficult to keep your hands on. We need a system which could be reduced to a telephone report if needed.

DR. GILLIAM: I think your nursing home index is a wonderful idea and my suggestion is only towards exploring the desirability of modifying it for extension to other areas.

DR. FISHER: May we flip over to the "discussion outline", B, Dr. Gordon, do we now have adequate methods for measuring the morbidity in a community in relation to air pollution?

DR. GORDON: I think my answer is the same as Dr. Smith's: What is air pollution in the first place? From the standpoint of measuring morbidity in the community alone, without reference to air pollution, you have methods that are possible, but they certainly are not now being used to study air pollution. Therefore, I should say that "No" is the answer to that question.

DR. BRESLOW: May I ask Dr. Gordon to discuss these possible methods?

DR. GORDON: The possible method is the very expensive and time-consuming one of periodic survey. It has been done many times of course, as you all know. Therefore, it is a possible method, but it certainly isn't an immediately or readily available method.

DR. GILLIAM: In relation to your initial answer to Wil's question, you certainly agree that if there is such a thing as air pollution and it has deleterious health effects, it is a place disease and it should be manifest by differences in disease with regard to place.

DR. GORDON: Quite so.

DR. GILLIAM: One obvious thing you want, then, is some knowledge of disease with regard to place.

DR. GORDON: Quite so.

DR. GILLIAM: In connection with studies of mortality by place, at lunch I was asking Mr. Manos about these preliminary tabulations you have distributed, which appear to be crude rates. It was my understanding that Dr. Dorn was going to develop these in the form of mortality ratios with adjustment for not only age but race.

MRS. GLEESON: Yes. There will be age, race, and sex on the different rates for all of these.

DR. GILLIAM: Personally I like the indirect method where you come up with one figure. I thought that was the way he was going to do it.

You have such small components of non-white population in some areas, and in various age groups, that the indirect method of age and race adjustment is virtually necessary.

MRS. GLEESON: In his analysis he may do that. He is now engaged in analyzing by race.

DR. GILLIAM: I notice you leave out the largest component of lung cancer in the classification here, the deaths attributed to lung cancer, but not specified whether primary or secondary. The few studies that have been done on that indicate that the bulk of them are actually primary in the lung, but the doctors just say cancer of the lung. So International List Nos. 162 and 163 are generally included together. You have cut the rate in half by limiting consideration to No. 162.

DR. MANCUSO: I haven't heard any reference to residence. The word has been mentioned twice, but it hasn't been emphasized sufficiently, I think. One problem, of course, is measuring the extent of exposure. There are two types of residence, which I refer to as death residence: residence at the time of death, and residence exposure years, which refers to the number of years an individual has been a resident in an area. I believe that cancer mortality data should be reconstructed according to residence exposure years and then try to determine what geographical differences may exist; once these geographical differences have been detected, then to further refine subsequent studies to determine why these differences exist.

We have had quite a bit of experience in occupational exposure, and we find that based upon the number of years of exposure to a toxic substance in industry and the latent period of the disease, you will get different types of statistics. I think the same problem exists in regard to the population at large. In effect in industry they are captive populations. If you compute your rates according to one year of exposure to a certain substance in industry, you get one picture; but if a disease takes ten years of exposure and you base your figures on the number of people who have been exposed for ten years, you get an entirely different picture.

So I should think that one of the points of emphasis should be residence. I would like to see a series of studies undertaken in regard to residence, one in particular being comparing mortality by death residence and mortality by residence exposure years in order to determine whether there is a difference in mortality pattern between the two.

If there is no difference in mortality pattern, then it would mean that it would not be necessary to go through this expensive and time-consuming operation of determining residence exposure years, very similar to the exploratory situation now in regard to the accuracy of death certificates, and so forth. How does the mortality pattern change when you compute your statistics based upon the cause of death on the death certificate and, if you make a further study, based upon the histological confirmation of diagnosis. We have the same problem here in regard to atmospheric pollution. We really do not know, though we suspect, that there may be a difference between the causes of death of different types based upon death residence and by residence exposure years.

The fact of migration which Les Breslow mentioned is extremely important. That changes the mortality pattern in Florida. It would also change the pattern in California. I would suspect that if the mortality data were reconstructed according to years of residence, the present mortality picture would change in California and would do so definitely in Florida. Residence is an indication of the time of exposure. In regard to morbidity it is essential that residence be taken also. People may migrate to an area because of certain medical or surgical facilities. They may migrate to an area because of job opportunities. They may migrate to an area because of the climate. The age distribution of an area may be seriously affected by this migration.

The other factor that I would like to emphasize is the difficulty of making comparable studies and relating them back to a period of time, some 20 or 30 years ago. I have the feeling in regard to atmospheric pollution that it might be advisable to accept as an index of atmospheric pollution, population density itself. I know that there are a number of weaknesses to that concept, but I am wondering whether the advantages might be greater than the weaknesses. We have to look for some criterion, some uniform basic information which is available, and the only characteristic that I am acquainted with, is that it would be possible to reconstruct population characteristics to a certain degree throughout the United States in different regions over the past 30 years, and so on.

If we admit that atmospheric pollution is not a single constituent but is related to industrial growth, the number of houses, the number of incinerators, the number of automobiles, the one common demoninator concomitant with these growths is people. I feel that regardless of the limitation, the initial screening procedure could be done based upon comparisons of cities on population density.

There are several studies that I think could be undertaken or pursued rather strongly. One is this study that Haenzel had at the National Cancer Institute in which they are taking the current 1956 lung cancer deaths and making a study of cigarette smoking as compared with Census data. The information that we have is that they also record the Social Security number so that occupations can be reconstructed from the Bureau of Old-Age and Survivors' Insurance, that is, their industrial employment, and residence data, so that the three factors which seem to be associated with lung cancer at the present time -- smoking, occupation, and residence in an urban area -- might be considered. I think, too, that the U. S. Census in making its periodic surveys could very well include residence data. I know that they include the state which is the place of birth; but, I would recommend that they change that to the city of birth to follow a suggestion that Dr. Ciocco made to me earlier while we were exploring this phenomenon, so that at subsequent times we might be able to have population data related to people who were resident at the time of the survey and who were born in that particular city, assuming that the individual being resident at the time of the survey had lived in that city a predominant portion of this time.

I think, therefore, that through the Census and through a number of other studies that are now under way, but which are not paying sufficient attention to residence, that something might be done.

Another study is the work that Dr. Dorn is doing in the ten-city areas in the United States on cancer morbidity. There is no reason why residence data could not be taken in regard to that and a comparison made on the distribution by length of residence in these various cities and see if there is any difference, and then tie it into a biological phenomenon to compare the histological sections of these various cities for these different types of cancer.

There is one other point that I believe that has not been mentioned, and that is the possibility of ingesting atmospheric pollutants. It comes back to the point that we are not really just focusing on lung cancer. One reason for studying mortality is that we have no idea what particular organ systems are being affected. It is conceivable for atmospheric pollutants to settle on a city water supply and for the people to drink that water supply, and it is possible in other forms, of course, with which you are acquainted with in regard to food.

The only other comment I would like to make is that I feel there is a definite need for coordination in regard to epidemiology. Whether there should be a center located within the Country in which all methods of this type of approach would be screened and recorded so that we could avoid duplication, I feel there is a definite need for an over-all continual analysis of the different approaches that are being made in different areas of the country.

DR. GILLIAM: Might I make a couple of comments on Tom's remarks. I am sorry Dr. Ciocco is not here because I have talked to him about one of the problems that Tom raises, this question of lifetime residence histories and occupational histories.

Except where you are dealing with a closed population in a specific industry, the inevitable problem comes when you have lifetime occupational histories of what to do with them after you have them. You have no denominator, and nobody, as far as I know, really has gone into the problem, the methodological, the bookkeeping, the statistical problems, of what to do with lifetime occupational data after you get them. The same to some extent, I am afraid, Tom, applies to your lifetime residence history. How to set them up, how to analyze them.

We have for some 12,000 cancer histories and controls, lifetime occupational histories and lifetime residential histories. The occupational histories are not of the kind that would suit an industrial hygienist. They are seriously deficient in that respect, but they do have enough of the change with time of occupation and of residence to permit a study of the methodological problems involved in what to do with them after you have them. We frankly don't know.

The other point with regard to residence: Tom, I think, was the first one to point out that in Cleveland -- or was it in Ohio as a whole -- the foreign-born had a significantly higher lung cancer rate than the native born. The magnitude of that excess was large enough to be noticeable; but, it was not as great as some of the other differences you have between some other variables in cancer of the lung. Nevertheless, it was there. The same thing has turned up in New Zealand. Immigrants to New Zealand, who have lived their first 35 years of life in Great Britain, experience a much larger lung cancer mortality than do either the native-born New Zealanders of English stock, or the English who immigrate when they are younger. Les and his group have turned up a similar situation with regard to another racial group in California. That is correct, isn't it, Les, with regard to foreign born?

DR. BRESLOW: Yes, for one group.

DR. GILLIAM: When Tom is talking about getting residence, might we look on non-residents in Washington as "immigrants", as "foreign born" in the same way? In spite of what I said about not knowing exactly what to do with residential history, I would like to know, for example, the previous residence of patients whose lung cancer occurs in Washington, which I believe is a relatively clean city from the standpoint of atmospheric pollution. I would suspect that a very high proportion of them have spent very little of their lives in Washington. When Washington is considered as a state, it has a significantly higher lung cancer rate than the other states. When it is considered as a large city, it is slightly excessive numerically but not significantly. Are the lung cancers in New Orleans in "immigrants" or in the "natives"? In so far as mortality data are concerned, New Orleans has the highest rate of the large cities, based on a two-year mortality experience. Are these cases among "immigrants" to New Orleans or are they "native born" or "foreign born"?

The disease that has been very frequently quoted as being related to atmospheric pollution, that I have the most familiarity with, is cancer of the lung. We have already shown, in so far as mortality data are concerned, and in so far as the ten-city survey data are concerned, that there are rather large regional variations. In the large cities of the Country there is a five-fold difference between the highest and the lowest in mortality rates. We have enough regional variation and evidence of this as a place disease in lung cancer at least, to begin to try to find what these differences are due to. I must confess that for this disease in which atmospheric pollution, recently at least, has attracted a great deal of prominence, I am not entirely clear how to plan an all-embracive, concerted effort which is likely to answer the question.

That is with regard to lung cancer. Sitting here listening to Les and to some others I have jotted down some completely unrelated notes stimulated by what they are saying. I hope I will remember them as ideas for certain approaches that flashed through my mind. I must confess that I would not now know, however, how to design an all-inclusive study to answer that one potential problem of atmospheric pollution.

DR. GAULD: Do I understand you to say you would not link this residence factor?

DR. GILLIAM: No, I don't mean that at all.

DR. GAULD: My understanding was that you said you couldn't use it because you didn't have basic population data.

DR. GILLIAM: Yes. But if you found that in Washington, for example, even the simple fact, if it turned out to be that way, that 40, 50 or 60 percent of the people had been here only three or four years, I think, if nothing else, is a lead. Exactly how to relate those cases back to the city to which they might belong, I haven't the foggiest notion, how to do and that is what is implied when you get into lifetime residential history. However, the simple fact that all of them were lifetime residents of Washington, or that a high proportion of them were not, is important information.

I agree wholeheartedly with Tom in getting both the occupational and the lifetime residence history. I am all in agreement. But the point I was first trying to make - I should have put it this way - is that a vital fundamental study is needed, a methodological study of exactly how to get the most out of lifetime residential and occupational histories once they are gotten. I don't know who would be interested in it, or competent, to do it. And it would not be simple. I would hope that the staff could add such a project to this very fine list they already have either planned or underway - and I must say they are to be tremendously complimented on how much progress they have made thus far.

In occupational histories, for example, you may have an average of two, three, or four different occupations in which a person has been employed during his lifetime. In one cancer study I know of, a person who had four or five different occupations during a lifetime prior to the development of cancer was assigned arbitrarily to the occupation, in which he had served a minimum of five years for which there was additionally evidence for an industrial exposure to some substance that was carcinogenic to animals. That kind of "dice loading" is no way to get at the possible role of some potential hazard.

DR. HEIMANN: Isn't it reasonable, Dr. Gilliam, to use such a procedure on an empirical basis, knowing that you are doing it on an empirical basis and hoping that from that you will develop further plans for what needs to be studied?

DR. GILLIAM: The real danger that has happened so frequently in the thing I was last mentioning, is that evidence collected that way has then been shouted from the rooftops, as proving that cancer of this kind is caused by an exposure in this occupation. Evidence loaded in that particular way, as far as I am concerned, doesn't even say that the people who work in that particular occupation are at increase risk to that particular cancer. I don't think it even says that.

Totally aside from loaded evidence of that kind, however, even when increased risk to a particular cancer has been undoubtedly demonstrated for some occupational group, it by no means necessarily follows that the occupation involves exposure to some chemical carcinogen. I can show you occupational data of the same kind for other diseases such as bronchitis, tuberculosis, or syphilis which indicate excessive risk to these diseases to the employees. Since we know the cause without which syphilis cannot occur, we do not conclude that the occupation involves work with a syphilogenic agent. There is undoubtedly a reason why employees in some occupations experience excessive risk to tuberculosis or syphilis, just as in lung cancer, but it is not because the work per se involves industrial exposure to a tuberculogenic or syphilogenic agent.

DR. HEIMANN: Isn't it true that what you are saying is that where you find association you are not necessarily proving a cause and effect relationship. That is accepted.

DR. GILLIAM: It usually isn't in cancer, at least.

DR. HEIMANN: Then what you are expected to do, as a person concerned with biological phenomena, is to see if there could be a cause and effect relationship biologically. Is it a sound one? You might then stick your neck out and say there is.

DR. GILLIAM: It is a rugged problem. Where you have a disease like silicosis or asbestosis, by very definition they can only occur in persons who are exposed to silica or to asbestos. The fact that it can be demonstrated that an occupational group has an excessive risk to lung cancer, or what have you, is tremendously important, but it does not necessarily mean that there is a specific agent to which they are exposed which causes it. Excessive or diminished risk to disease in any group is a tremendously important fact, and the whole field of epidemiology, of course, is directed toward finding and explaining mass differences.

The business that you mentioned first, Dr. Kleinfeld, of finding opportunities for getting reliable records of risk to various diseases which you may think are due to atmospheric pollution, in the environments to which a closed group of people are most exposed, is terrifically important. Perhaps you have better luck in New York than we do in the Federal Government, because at least in the Cancer Institute we find the door closed to us most of the time in getting the kind of records needed to answer that.

DR. KLEINFELD: This may in some way bear on the subject of single industries. I was just observing here that there are a number of industries in New York where there are single substances or predominantly single substances which are known to produce certain diseases. One is asbestos, where a definite pulmonary fibrosis can be produced and also carcinoma in increased incidence. I am thinking of Palmyra, New York, a small town in a flat section of the country, near Rochester. This is a single-industry town. It has 3000 people with close to 2000 working in this particular plant. Would that not serve as a good study not only in correlating but also possibly in giving a causal nexus to the incidence of (1) pulmonary fibrosis and (2) the occurrence of bronchogenic carcinoma?

DR. GILLIAM: The logistics are such that in a population of 3000 you don't accumulate lung cancer cases very fast. The only study that I recall where there is any good quantitative evidence that I think really shows an increased risk to lung cancer in asbestos workers is the one from England. The data from this country are of a different nature and are only suggestive. A record study in Palmyra, however, might be useful as exploratory.

Generally, in a population of male industrial workers you would expect only about one case of lung cancer per 2500 person-years at risk. So unless the mortality records were good there, and you made a retrospective study of records, it might take a long time to accumulate much.

DR. GAULD: In connection with your difficulty in the occupational or residence data, wouldn't it be possible to agree that there are all shades of occupations and all shades of residence and to pull the extremes out and compare them if you had the basic population data?

DR. GILLIAM: I should think you could. That has been done in a sense where you use as your basic population data census counts of the number of people in broad industrial groups for your population, and collect similar data for cases.

DR. GAULD: Forget about the vague shading off. Take the extremes.

DR. HEIMANN: The extremes of what, sir, would you say?

DR. GAULD: The people who have lived all their lives in a heavily industrialized area.

DR. GILLIAM: The man who has spent all his life in one occupation.

DR. GAULD: If you had that information on the Census reports you would be able to get your basic population.

DR. GILLIAM: Dr. Mancuso has done that in Ohio and provided some interesting leads with regard to some cancers.

DR. MANCUSO. Yes. I think it is not as hopeless as it may appear to be on the surface. We have done work for a number of years in regard to certain cancer sites. I was suggesting it more or less on principle rather than actually how it would be carried out; whether there would be agreement among the group with regard to the relative importance of residence data and how much effort or exploration should be made including that as part of the basic approach. I did not want to get into the problem of actually how one would work with the data. I thought that could be resolved by a group working out the technical aspects of it. Just as in industrial hygiene where we compute people who have been exposed 10 years or more to a given substance, you could also take given cities geographically, with residence for 20 years or more, and go on in that way.

DR. CIOCCO: I think you and I have discussed this before. I don't know what the mechanics of it would be from the standpoint of the vital statistics office but we do get information on the death certificates about birthplace. If you compared the people who have died in the same place in which they were born, with the people who die in a place different from that in which they were born, it might provide some leads. You could do such a study within communities or within areas.

As I say, I don't know what the mechanics would be from the standpoint of vital statistics, but the data are there and could be used.

DR. FLORIO: Couldn't that lead you to false conclusions? Aren't a great many people born in a place, leave it and then retire back to it?

DR. CIOCCO: You make an assumption there. Actually that isn't too bad an assumption to make. A lot of people stay put. We worry about migration; but, when you look at the census you see that a substantial portion of the population actually remains put.

DR. GORDON: Haven't you selection between urban and rural that would be quite material?

DR. CIOCCO: Suppose you work only within the urban zone. The point is to see if there are any differences. If there aren't any differences you don't worry about it any more, maybe mistakenly. But if there are differences you follow them up. I think it is the same point which Dr. Gilliam was making. You can't expect a full blown net result of some kind to come from this work, but since for this particular problem we haven't much of a handle yet, let's start looking for something.

DR. HEIMANN: Dr. Mancuso suggested that residence histories are important, and we have tended to agree with that in our Program. He also mentioned as an index of air pollution to use population data. I wonder what the group thinks of that as valid for inter-community comparison.

DR. MANCUSO: The point I was trying to make was that you could reconstruct what the population was geographically in 1920, 1930, 1940, 1950, for each given city and compare them. The point I was trying to raise was whether or not whatever associations exist in regard to atmospheric pollution are more inherently associated with the number of people themselves and whether that can be used as a criterion. I suggest it really as a matter of discussion because this problem of getting an atmospheric pollution index is extremely difficult and I am wondering whether this isn't equally as valid as the one being proposed.

DR. PAFFENBARGER: I haven't gotten by feet wet yet in chronic disease so I can't even qualify as a tyro. I would like to extend this discussion of denominator data a little bit further. I think we have reached the place as far as denominator data are concerned where we must rely on survey data. Even in the field of infectious disease it seems to me that morbidity or mortality data are entirely inadequate. I would wonder if in California through the State Health Survey such data as might classify as demonimator data are not available in the line of lifetime residential histories and lifetime occupational histories. Perhaps we wouldn't have the sequence of occupations for individuals, but certainly you would have occupational aids; that a person has been employed in such and such an industry for a certain length of time. Possibly in the National Health Survey questions could be devised to get at some of these questions of lifetime residential and lifetime occupational histories.

One other point I would like to make. Maybe you can answer this, Les. Do you have data which would classify as comparative material?

Although it is frequently difficult to get adequate population groups and compare the incidence of disease between individuals who are exposed and individuals who are not exposed to an air pollutant, let us say, it is relatively easy to get data on the frequency of exposure to a particular air pollutant in groups of individuals who have disease and in selected control subjects. In other words, where there is the difficulty to get incidence data, it is much easier to get frequency data. Perhaps this is an approach that merits consideration in the general field of air pollution studies.

DR. FISHER: Dr. Gordon is concerned, as were we all a while ago, with a discussion of what is air pollution. I am very happy to see that you got back in, Mr. Mackenzie.

MR. MACKENZIE: I would like to make a comment on the so-called indices of pollution. I heard something earlier this morning about the difficulties of arriving at a satisfactory index. I think everything that has been said is true. One particular aspect of it, however, I did not hear very great emphasis put upon, which I think might deserve further comment. The exposure to pollution generally you might consider as being dependent on two things principally, first the quantity of pollutant which is discharged into the atmosphere in which the people are living and, secondly, the rapidity with which those polluting substances are dispersed and diluted in the atmosphere which is available for receiving it. The second, of course, is dependent upon the weather variable.

We have found in some fairly intensive area surveys that the variation within a specific, limited geographic area is greater from time to time than it is within various portions of a particular area or region that we have been considering and that these time variations are largely tied in with weather variables. I think in any index of pollution, therefore, it will be highly significant that the weather variables which are appropriate be considered, both with respect to variations in a particular area from time to time and also with respect to variations from one area to another as to the frequency with which the specific weather conditions produce higher concentrations of pollution than is normally the case.

Therefore, whatever index of pollution you consider for correlation with you health standards I would urge that you give full significance to the contribution of the weather. I think it may ultimately be found that in certain circumstances you can arrive possibly at per capita contributions due to general community activities and to the community of specific types of industries, but that after you arrive at such figures then those must be tempered very greatly by the specific geographic and climatological characteristics of the specific area.

The meteorologists can give you general subjective opinions about these matters. They do not, however, have as good quantitative information about the specific measurements that have to be taken, nor have these things that they think should be taken been observed routinely in very many places at all. Los Angeles, of course, is the prime exception to this, as in connection with the measurement of specific pollutant substances. In most areas the attention to meterological variables has not been given the attention it merits in connection with this overall subject.

DR. DUBLIN: From what you have said are we to understand that you are speaking of the meteorological factor -- whether it affects noticeable subjective discomfort, or what? It seems to me that there could be a very large meteorological element when it comes to people's awareness of the fact that the air is polluted.

MR. MACKENZIE: For the areas in which this has been given more attention than others, the correlation holds true, I would say, across the board; that is, with regard to both the objective measurements and with regard to the evidences from the people themselves in the way of complaints.

DR. FISHER: Mac, relating these health effect studies to instrumentation, I think we pick up there the story that we got in Chicago. During the strikes in 1949 there was an intensive sampling done at what would logically appear to be the heart of an industrialized area. And when the strike was over and work was resumed the instrumentation showed exactly the same background and same atmospheric pollution after the strike as occurred during the strike and again before the strike. The instrumentation in the middle of the strike district was simply measuring the gross background pollution from the whole city of Chicago. They failed even to watch the wind direction on the day of instrumentation.

In some studies in the Porton, England laboratories where they are working with wood smoke, fuel oil smoke, sulfur dioxide, and sulfuric acid mists, it is stated that effects may be measured and a reasonable amount of duplication obtained. When temperature goes down, when humidity goes up, the effects of either of those gases with or without smoke is vastly increased. There is of course the effect in the air pollution disease, bronchitis. As mentioned in the British Medical Council reports, there is an increase in bronchitis. There is a decay in the status of people who have chronic bronchitis during periods of cold and during periods of increased humidity. There is a definite additive affect on days which are described as being smoggy. Cold and moisture do accentuate the effect of air pollutants both in the laboratory and in community observations.

DR. CIOCCO: Isn't this a problem of measurement itself? For example, how do they get around this problem in industry when they attempt to determine what the maximum allowable concentrations should be? How did they get around that in those cases where MAC's have been established? Weren't they supposed to measure the amount of things they assumed the individual was in contact with, the amount of dust or whatever it is, or did they just assume that all other conditions were equal when making the observations that led to the MAC's?

DR. FISHER: I am glad Dr. Cooper is in the audience.

DR. COOPER: I think the allowable concentrations which appear in the literature were very rigid human exposure data over a long period of time with regard to chronic effects.

DR. CIOCCO: I mean do they actually measure the amount of stuff that presumably the individuals breathed?

DR. COOPER: Certainly with regard to the dust diseases our methods lack a great deal of precision. We were not always sure we measured the right thing. We are particularly fortunate, I think, that we get as good results as we sometimes appear to be getting because the basic data were not very solid. Actually, Dr. Heimann, who has had much more experience on this, I think could comment on that question.

DR. HEIMANN: One point to make, Tony, is that there are no winds blowing inside a factory. Here we are talking about a community where the winds are likely to be blowing in any direction and, as Mac pointed out, change the levels of pollution, the levels of toxic substances present in the air. Inside a factory you get a fairly constant level. Most of the time the way the MAC evolves is that the engineer has had to walk around right next to the man and have his impinger, or whatever he is using to collect a sample, right at the man's nose. This is something we don't expect to be able to do in our air pollution studies. Information of this kind will not be available because of the number of communities that we will have to compare, intra-community and for inter-community disease profiles and mortality profiles. We just won't be able to get facts of actual measurements of what is in the air of these communities.

DR. KLEINFELD: I think there is an answer to the question of weather. Certainly there is ample evidence of those who have studied particulate matter that when the weather changes, when there is increase in humidity there is greater tension of particulate matter. Practices that might explain why at one time, or day, or year or season there may be more complaints. The other factor is allergy. We know that certain individuals who have asthma or hay fever, when there is rain may still complain and still have respiratory effects. They have one allergy to the allergen ragweed, and then at the same time they may have symptoms of so-called chemical or weather allergy, as allergists prefer to call it.

DR. BRESLOW: I would like to respond to the question that Ralph raised a moment ago about getting denominator data, particularly occupational history and residence exposure, by the survey method. He asked specifically about that in the California Health Surveys. In the first survey of 10,000 households in the State we got only the most elementary residence data, that is, where people were living now and where they were born. In the second Survey we moved a step ahead and got information as to how long they had been in their current residence and in their current occupation. One could get as detailed information as desired by the survey method. So many demands are being placed upon the survey method that the problem is where to draw the line as to detail in any particular series of items.

I am inclined to agree with you that we should go much further in detail as to occupational and residence histories or exposure-years by the survey method. I would also concur that it is probably the ideal way to get denominator information.

DR. GILLIAM: I should like to go back to a remark concerning strikes which result in plants being closed down. I wonder if there would be any merit in exploring the possibility of examining mortality trends, by broad causes, in one or two large industrial areas where during the depression practically the entire industrial plant was shut down for long periods of time. This would be to determine if any change in trends of disease in those communities could be related to the shutdown.

DR. FISHER: Do you want to comment on that, Dr. Heimann?

DR. HEIMANN: I would like to ask Dr. Gilliam about whether you would be able to account for the effect of the changing socio-economic pattern of the community as well under those conditions.

DR. GILLIAM: I have no idea. It is something that ran through my mind when you were first mentioning the strike business. I just wanted to suggest it as a possibility or idea that you might want to consider.

DR. CIOCCO: Perrott and Sydenstricker made a survey during the depression of people who had been laid off their jobs. They found increased sickness in those who had. Among the cities that were surveyed at that time was Pittsburgh. I got interested in the possibility of going back to those old data, but I never could. In the case I mentioned the relation would be the reverse of the one suggested.

DR. GILLIAM: It may be an important point.

DR. HEIMANN: Was it actual sickness or complaints of sickness? Many such people are still entitled to receive insurance benefits and they have to prove that they are ill. Suddenly all those illnesses that they had before which they never reported begin to be reported.

DR. CIOCCO: There may have been reasons similar to the one you mentioned, but it wasn't that one.

DR. FRYE: Did you get any data during the recent strike in Donora?

DR. HEIMANN: I think it was decided by Mr. Manos and Mrs. Fisher that the best kind of data to collect for strike periods was not the current data, because of the difficulty of getting that for some time to come. They can possibly collect that maybe a year or two from now. What they did instead of that was to go back to former strikes and see what they showed.

MR. MANOS: We looked at a strike in 1952. Our first look at it was in the right direction. We are getting more data.

DR. HEIMANN: Dr. Frye, you will be interested to know that we also started an alert system in our own group. As soon as we hear that a strike may occur some place, that there is going to be an appreciable work stoppage in some area of the country or in some type of industry, we then are going to set up a program for studying what happens there. Mrs. Fisher and Mr. Manos are planning for that.

MR. MACKENZIE: I might say in that connection we have taken a few environmental measurements of some of the communities that were affected by the recent steel strike. Those data are not available, but the measurements of particulate loadings in the community, and so on, were taken.

DR. WENTWORTH: Some time ago you addressed us to Point B on the "discussion outline", Do we have adequate methods for gathering data? and in line with Dr. Smith's point about the immediate effects I would like to say that the Detroit-Windsor study was addressed to the problem of the immediate effects of the change in certain components of the air in relation to the appearance of illness. Let us assume for a moment that the study gathered the data that it set out to gather. It seems to me that there is evidence that the morbidity or the appearance or incidence of certain symptom complexes can be gathered on an interview basis. Suppose this were done, the problem that would be faced in Detroit would still be, With what is this to be associated? Their index of air pollution in this instance was SO_2 concentration. They have already attempted to make an association and find there is none in the levels of fluctuation of the incidence of certain symptom complexes and the fluctuation of concentration of SO_2. One might say, then, there is no association with air pollution if the SO_2 concentration is air pollution: but is it?

I don't mean to imply that the epidemiologic study should not be done, but certainly unless one has some indication of both sides of the equation even if one perfectly gathers the data, of what real value is it going to be unless it is supported by some toxicological and/or physiological data?

Earlier this morning you pointed out a number of studies that had been done. I wondered if from those there had been enough leads gathered to direct the future design of morbidity studies.

DR. SMITH: I think we have to recognize that we are going to draw a lot of blanks. It may be that many times we shall be pursuing wrong associations. But I think we have to continue to test what associations we have already got at hand. If those don't test out we hope that we shall have some fresh associations we can try, appreciating that association doesn't necessarily mean cause and effect.

DR. GILLIAM: I was just going to emphasize what you were saying; a valid observation that there is or is not an association with SO_2 or other pollutant, is of value. It is a step. What it means is something else. I think, particularly in these epidemiological studies, if you were asked to demonstrate how many of them are going to give yes or no answers related to atmospheric pollution, you would have a tough job of defending them. I think nevertheless that is entirely beside the point.

DR. WENTWORTH: It probably is; but, as Dr. Gordon points out, morbidity gathering techniques are extremely expensive and time-consuming, and when one has one that he really trusts when he is through, a good bit of luck has played a part in it. It is not something that turns out properly every day. The basic question here seems to be what should the money be used for that would be most useful at this time.

I think my question really is: Is there enough background data, toxicologic and physiologic, to warrant full-scale application of the morbidity technique as it relates to air pollution at this time?

DR. HEIMANN: We think there is, Dr. Wentworth. We think in these terms at the moment: That the Donora episode, the Meuse Valley episode, and the episodes that have occurred in London were similar in the sense that there was some irritant present in the air which induced symptoms referable to the exposed mucous membrane. To that degree we seem to agree. Therefore, in spite of some of the objections raised, we are aiming at the moment in that direction, the direction of the respiratory tract, and the cardio-respiratory system as affected by air pollution.

DR. GILLIAM: I hope the results of the Detroit study are never buried. Even though they may have had difficulties from start to finish, I hope that they are not buried. One difficulty in this whole field is the number of starts and stops. I would battle for somebody to get a project that I thought was basically unsound provided the person himself were sound and provided there was a chance that he was going to have some continuity in that field. It is only through mistakes that we learn. I hope these errors, as you imply, are not buried. You are going to make enough errors of your own, and it is nice to try to avoid the errors that somebody else has made before you.

DR. FISHER: "Discussion Outline": "Are there specific diseases caused by air pollution?" The British describe bronchitis. It doesn't correspond to anything here. Probably most of you know more about what they call bronchitis than we do.

The bronchitis in California which I can now testify is real, if you will excuse my previous skepticism, Dr. Breslow. The English bronchitis doesn't appear to break down very well to a specific disease. Is there any reason to say we know now there is a specific disease? Thus far we say no.

DR. GILLIAM: There are specific diseases associated with it, surely.

DR. FISHER: "are there diseases that occur more frequently in individuals exposed to air pollution than in those who are not exposed?"

DR. GILLIAM: The first one says "Caused by air pollution." There are certainly diseases that are associated with air pollution.

DR. FRYE: Are you talking about frank disease or changes or what?

DR. GILLIAM: I am trying to think of an English study by Hewitt, which was published quite recently, directed toward respiratory diseases, in the Journal of Preventive and Social Medicine. (Hewitt, David: Mortality in the London Boroughs, 1950-52, with special reference to Respiratory Disease. Brit. J. Prev. & Social Med. 10: 45, April 1956). He made what seemed to me a pretty clear case for certain respiratory diseases associated with air pollution. It was a very indirect way of going about it, but a very nice study.

DR. SMITH: In other words, we could just say we don't know at the present stage.

DR. GORDON: I think it is fair to say that in Britain there is much more of a belief in such an association than there is in this country.

DR. GILLIAM: Yes.

DR. HEIMANN: In view of all the discussion which has been devoted to methodology, to what extent do you suggest that we ought initially to concentrate on methodological development? To what extent, Dr. Smith, do you think we ought to go right ahead and do the studies?

DR. SMITH: I hope I haven't given the impression that we ought to do studies without having any method, because one of the things that I was trying to smoke out in discussing Detroit was the fundamental difference of survey and the record diary. Thus, I was supporting what Dr. Gordon was saying about the values of survey and what was already indicated by Les. We have survey methodology as one procedure that can be carried out. Stanley very appropriately indicates that we can not confine ourselves to survey data, that we have also to do our best to get our mortality data into usable form. I think that we could very well consider the "B" part very quickly, both limitations and advantages. The fact is that we have to use all of them. These methods are not exclusive. I do think we have to get on with learning the lessons, for instance, of Detroit. The Detroit experience emphasizes the care which must be taken in setting up such studies. We must get on with these epidemiological studies, but they must be set up in a manner which is basically sound. Then they must be sufficiently flexible, as Dr. Gordon has emphasized, to shift if changes become appropriate.

DR. HEIMANN: From what Dr. Gordon said and from what you said, I determine that a portion of our efforts should be concentrated on the development of method.

DR. SMITH: And just as an example, the California morbidity study financed by N.I.H. research grants, originally was devoted to methodology in San Jose. Les, would you point out what was your conclusion?

Dr. Breslow: Our conclusion was that the method was sufficiently valid to justify statewide application, which is what we then carried out. The question of operations versus methodological development is really an artificial question, because one can examine methodology at the same time that one applies it, and the whole question is in interpretation. One should be cautious in interpreting the results of methods which are subject to criticism, at least by some. We ought to proceed with the application of survey methodology in order to determine morbidity as it might be influenced by air pollution. I at least am sufficiently convinced of the validity of the survey method to believe that we ought to proceed.

One more word on this question: That is in respect to cost. It is a sad day when we have to determine methods primarily on the basis of cost, with the indications from the Congress and elsewhere of their desire to get on with health research. The time has come when those who are supposed to be technically competent in the field can say that this is the method of choice or these are the methods of choice, rather than these are the methods we must use because the best methods cost too much.

DR. HEIMANN: The time has come for that?

DR. BRESLOW: That is right, and to ask for funds to pursue those methods even though they might be quite expensive. One could certainly undertake a critique of vital statistics as a basic epidemiologic resource. With all of our experience in vital statistics one could write a bigger book of criticism of vital statistics as a source of mortality data than one could write of the survey method in getting morbidity data. Yet we depend on vital statistics and devote tremendous amounts of money to getting them.

Because of the tremendous public interest now -- and we should all be conscious of it -- in getting on with studies of long-term illness and the effects of air pollution and other influences upon long-term illness, we should not be modest in requesting funds. That applies even to the $5 million authorization. I see no reason to be limited by such an authorization.

DR. HEIMANN: Then do I understand that you think we ought to go right ahead and do the studies and in them develop our method as we go along?

DR. BRESLOW: That is my feeling.

DR. OSBORNE: If I may say a word. The $5 million limitation was placed upon us by Congress. We have very little choice in that matter.

DR. BRESLOW: I appreciate that. My point is that the public is now thoroughly with us in pursuit of these studies and we should not be overly modest as technicians in our proposals. Congress will raise the authorization if shown the need. That is the point I am making.

DR. SMITH: Congress might be willing to be persuaded to increase it over $5 million, and there is no reason, if we can have sufficient imagination and show that we could use more, that we wouldn't be perfectly justified. It wouldn't be necessary for the Public Health Service to ask for any addition. We can assure you there are certain Congressmen who are so acutely aware of this problem that they would be happy to be able to make representations for significantly more. So I hope that we don't consider that this is necessarily a ceiling. It is within the Public Health Service. But if we can show that we can do more, let's do it.

DR. GILLIAM: In connection with what Les is saying, in a meeting yesterday with regard to cancer, a particular item in our funds had been very materially increased without our request, and someone wanted to know why. I think the only answer was what Dr. Smith gave, that Congress is sensitive to the health of the people right now and they are in effect pushing money on us which we have not asked for.

DR. BRESLOW: That doesn't mean of course we ought to throw money away wildly.

DR. HEIMANN: Are you implying that the reason we are looking for newer methods is because we are looking for cheaper methods.

DR. BRESLOW: We should not decline to embark upon the exploitation of methods, even though we are not fully aware of all the implications of these methods, simply because they are expensive. That is the point I would make.

DR. CIOCCO: I think that this a good point. On the other hand, I think it is well to emphasize how little we know and to keep that always before us. At times we may wish to increase the cost of a study simply because we want some methodologic work done.

DR. BRESLOW: That is right.

DR. CIOCCO: I think that is the thing to bring out. In talking about methods I was thinking first in terms of the method of obtaining data and the method of analyzing data, which can be two different kinds of methods and on which we need a good deal of increased knowledge. But somewhere here I missed the answer to the question which was raised a moment ago when you asked the first series of questions, Dr. Fisher, as to specific diseases.

In other words, somewhere along the line you would want to get observations on individuals, whether it is a disease or not. How can you do that? We are dealing here with something which some one some day may fit into a diagnostic box. Isn't the problem to which we would like the answer this: Is there a little box that can be formed that is sort of specific for air pollution? You cannot expect to answer this question until you start working on it. Such studies are not the same kind of studies that we have been talking about. They are the kind of studies that in the past were done by the clinician who observed something at the bedside and began to lay down some rules as to what he thought was a peculiar series of syndrome. We have been talking about, on the one hand, studies on tissues, studies on toxicological properties of materials, and so on, and on the other, the full-fledged "epidemiologic" survey. Somewhere in between there ought to be studies something which begin to clarify this question, which start out with some idea that there are certain peculiarities which can be observed in relation to people who are exposed either acutely or chronically to air pollution.

DR. OSBORNE: Have you discussed the thinking of the pulmonary physiologists along this line?

DR. FISHER: We are hoping under the general heading of pulmonary function and pulmonary physiology to get some intensive clinical studies and follow-ups of population groups with relation to episodes of air pollution. We are looking for some signs and symptoms which may be referred directly to air pollution.

The pulmonary physologists seem to sense there is some hope that we can find some changes which go along with air pollution. Perhaps I am optimistic about it.

DR. OSBORNE: If I recall correctly they were quite interested in what the group of epidemiologists might think about the feasibility.

DR. FISHER: One small group, let us say a very small group, had one test they hoped was going to be applicable to large populations. Another worker had a battery of tests which he thought would be meaningful in comparing populations and would enable him to break up some people who had suffered from air pollution or from residence in urban communities which do have air pollution. He got that far and then he said, "Now I need epidemiological help. How do I go about doing it? Can the epidemiologists tell me how to take my battery of tests and go out and look at a population or a series of communities?"

DR. HEIMANN: May I return to Dr. Ciocco's question? Dr. David was out at Donora during the time of our study there. Dr. David, do you want to talk about what you found?

DR. DAVID: Without asking leading questions, we tried to determine whether there was, let us say, a peculiar syndrome. And we did find that the majority of the people -- we interviewed several hundred -- had groups of symptoms. As I recall, there was retrosternal pain. Almost every one complained of that. There were a few other things in terms that made one think of an irritant of the mucous membranes. In a small percentage of cases there was eye irritations. So, in this group a predominant number of people named similar types of symptoms that would make one think of some irritant to the mucous membranes.

Together with that we attempted to do as careful a physical examination as we could in the field. That revealed very little or nothing of significance that I recall.

We also did some selected blood studies and some urine determinations. We found nothing unusual there. We did attempt this very thing of trying to see whether there was a little box which, as you say, would be peculiar to air pollution in this episode.

DR. CIOCCO: I would like to see some money spent on that kind of study.

DR. FLORIO: Because you find that little box, though, it may have no significance. I think there have been instances of that sort. Isn't anthracosis one of them, where you have all this blackening of the lungs by coal, but still am I correct in thinking there is nothing of significance there as far as health is concerned?

DR. BRESLOW: You are not correct. Recent work shows that this condition does have great health significance.

DR. FLORIO: Perhaps I picked the wrong example. Because there is a change, however, I don't think it necessarily follows that this change is harmful or bad.

DR. CIOCCO: Let's find the change first.

DR. HEIMANN: The term "survey method" has been used here quite a good deal. Each one of you who has used it undoubtedly knows exactly what he means. But I wonder if we all mean the same thing by the term. What does "survey" mean? Does it mean a complete physical examination of every person in every household in a given community? Does it mean, on the other hand, having selected an appropriate sample, going around and asking any person who answers the doorbell who is sick and what sickness has he had? Does it mean keeping a calendar? What are the other methods that might be available, and what do you think of the various methods that are used for collecting morbidity data -- assuming that we can come up with some indexes of air pollution for any given community?

DR. GILLIAM: That is a large assumption.

DR. HEIMANN: I agree that it is. If you would rather, we would want help from you on that. We have one suggestion or a couple of suggestions of what to use as indexes of air pollution. We are going to try them all out. But what about the methods of collecting morbidity data?

DR. CIOCCO: Shall we say there are certain methods, none of which any of us would be willing to bet his life on, and some of which, seriously, are at fault simply because we don't know what questions to ask. By "survey method" I had thought of the household survey of the interview type, which can be modified in various ways. You can add to the interview physical examinations or some kind of screening test.

DR. SMITH: Tony, wouldn't you mention, too, that the method by which the individual is selected for the interview is a basis?

DR. GORDON: You mean your sample?

DR. CIOCCO: The selection of the group to study is an important part of the collection of data. Such selection should be related to what you finally plan to do at the moment because a specific sample may be a good sample for certain objectives and not for others.

Nevertheless, we have now accumulated a considerable amount of experience throughout the country as to the value and the relative efficiency of various aspects of survey design - admittedly not yet enough. I hate to stress this point, but I think our real weakness -- and we are worrying about it now for Donora -- is exactly what questions to ask. You can get, in general, a fairly accurate answer if you ask a pretty precise question and if it is something that the person can recall.

DR. GORDON: With better answers for some things than for others.

DR. CIOCCO: Yes. The same of course would apply when you do a screening test of some kind. For whatever the screening test is worth, you can get fairly reliable information. But the problem is: Do we have the proper screening test? Do we know the proper questions to ask? Do we know the proper physical examination to make?

DR. FLORIO: Are there any possibilities in experimental epidemiology in animals? You can't ask the animals any questions, but maybe they don't gain weight; maybe there are some other things that these animals do or don't do that will give us the clue. How about experimental epidemiology of that sort, done with animal colonies?

DR. GORDON: You have a good example in Ford's work on radiation. It is much the same problem.

DR. HEIMANN: Isn't that being done by Kotin in California?

DR. FLORIO: Are there no clues there? Isn't it far enough along?

DR. BRESLOW: Kotin had pretty well given up finding anything in experimental animals other than neoplastic disease, which he is still pursuing, until recently. He has now shifted back somewhat to possible physiological effects of air pollution other than neoplastic disease. As Dr. Heimann says, he probably is farther along in that than any other experimental investigator.

DR. CIOCCO: There is also the use of routine data. I feel that sometimes we use routine data simply because we have them.

DR. GORDON: Suppose it doesn't fit.

DR. CIOCCO: That is the problem.

DR. HEIMANN: This is the kind of material that Jablon spoke about of the retrospective type that is available in the VA? Is that what you had in mind?

DR. CIOCCO: No. I was thinking more of what you can get, let us say, in an industrial plant where you have data, for example, on compensation claims for absences over eight days, or something like that. You see, routine data are usually available because you need them for some other purposes. If that purpose fits yours, you are in position to utilize the data; if the purpose differs from yours, there is little advantage in seeking to use the data. I was recently going over again the report on the study on the Health of the Chromate workers and I was rather impressed by the fact that what amounted to routine absenteeism data, really indicated the higher risk of respiratory diseases among chromate workers. So there are routine data which can be useful sometimes.

DR. HEIMANN: Such data as would be available in HIP, for example.

DR. CIOCCO: Yes, but where would you find similar populations with the proper kinds of exposures?

DR. FISHER: Let's mention one possibility we have. We have a fair possibility of getting into Birmingham, Nashville and Louisville, just to pick three that are possible. The Red Valley of Birmingham is pretty heavily polluted both for industry and residence and it is polluted the year around. Nashville has a 6-month clean, 6-month dirty part of the year. That is principally, again, coal smoke. Louisville, on the other hand, is almost clean. At least it is clean with respect to coal smoke. There is one small area that is under study, but that doesn't affect the whole place. There are hospitals there. The populations are roughly comparable. Should we go into those and get something which might be meaningful?

DR. CIOCCO: In my old age I am getting scared of comparisons between communities.

DR. GORDON: I am older than you are.

DR. FISHER: You are more scared? If we go into Birmingham on one of these, the people who get enough money to move, move into the next valley south of Red Valley. They become managers or rise in the community and they go on down to the third valley, whichever one that is. So they remove their families from the areas of pollution.

DR. FLORIO: You have a lot of other differences there, too.

DR. FISHER: Oh, yes.

DR. HEIMANN: Tom, may I ask you a question: This is in line with one of the things you said and also Mr. Jablon was offering. How much emphasis should be devoted to analyzing data in various communities already available rather than collecting new data? We realize from what you said, Dr. Breslow, that cost is of less consideration here, but still in terms of what you get in a reasonable period of time, which would be preferable?

DR. MANCUSO: My preference would be to latch on to those projects which are already available or under way and the use of available data, because getting this base-line data as far as I am concerned is one of the most important aspects of it. Right now until this initial project is instituted in 169 sub economic regions of the United States by 100-odd causes of death, we actually do not know the real geographical differences as far as mortality patterns are concerned.

I think our problem here is very similar to our problem in analytical chemistry. There are those who are very much concerned about searching directly and specifically for the unknown, whose characteristics we do not know and whose chemical tests to identify the various chemicals we do not know; and, then, those who feel that first we have to breakdown the chemical compound into some broad categories and then further analyze and refine them down. I belong to the latter school of thought.

DR. KLEINFELD: May I interject a comment which answers the question from a somewhat different aspect? I agree with Tom that both prospective and retrospective data are important. This is especially true of a town where it is possible to get significant morbidity and mortality data and where significant growth may be expected. Messina, in New York State, is one good example. Messina has a single large industry; within two years the St. Lawrence Waterway will be completed and Messina may be expected to become a large and diversified industrial community. If now one goes there and studies this single industry town retrospectively, criteria may be developed for prospective studies in the light of the changes brought by industrialization. This is just one example of planning for more meaningful prospective studies in the light of retrospective data.

DR. HEIMANN: To do both in the same place?

DR. KLEINFELD: To take advantage of both, one as a control and the other as a future study by comparison.

DR. DAVID: That is very important.

DR. HEIMANN: We thought of some things and some others have been suggested here, sources for information, sources already in progress. On a preliminary basis we have looked into Veterans Administration, Social Security, Vital Records office, and insurance company data. I wonder if any of you have had experience with other sources of data. We have mentioned medical data from plants, and HIP. What other kinds of data might there be?

DR. KLEINFELD: Hospital departments, workmen's compensation boards, Blue Shields.

DR. CIOCCO: In all these cases the real problem is to get at the base population.

DR. HEIMANN: Have you any other ideas, Tom?

DR. MANCUSO: I want to bring up again the subject of life insurance. There are two patterns of study in life insurance, one relating to disability and one relating to ordinary life insurance. We had considered at one time a disability insurance project associated with the study done by the Society of Actuaries of some 625,000 people who entered life insurance coverage with identifiable characteristics related to a specific disability, whether it was bronchial asthma, bronchitis, diabetes and so on. These people have been followed over many years. Unfortunately, because of some difficulty in determining the true residence in regard to them, that study was unable to come to pass. It still does not deny the fact that if you wanted to make observations on long-term cohorts it would be possible to establish in different cities in the United States all those individuals who entered insurance coverage as of a given year, within a given age group, with other essential characteristics, since all people entering life insurance have certain characteristics identified. So you could compare over a period of years the same cohort, that is, the deaths, the mortality, and life expectancy and the change in the mortality pattern of these different cohorts, by different cities.

Then of course the major problem is how to rate these particular cities in regard to difference in atmospheric pollution or some other phenomenon relating to atmospheric pollution. I come back to this residence exposure years and believe that it is necessary to establish cohorts of a given time period many years ago in these respective cities and to have followed them in some way. The only way I could think of was through the ordinary life insurance approach, because they have the deaths when they occur and you can get the cause of death from that. There are many, many millions of people who have entered life insurance. The only problem that I see is that it may be an expensive proposition; but, excluding that for the moment, that is the only project that I can think of that has the least number of problems as far as identifying the cohort with the same characteristics that you want in a given period of time without having to wait another 20 or 30 years.

DR. GAULD: You can get that from the Veterans. I think Mr. Jablon brought that out.

DR. MANCUSO: That is true. The problem with the Veterans of course is the additional factor of having been a veteran, whether that had anything to do with it or not. I think eventually we have to realize that if we are going to measure long-term effects, these long-term effects may be in terms of 20, 30, or 40 years. If what we have now is any indication of some phenomenon which occurred through a series of temporary physiological insults which have occurred over so many years, then we have to go back to the original cohort. Who was exposed? Who were the people at risk?

DR. KLEINFELD: The Union Health Center is another source, since they are enlarging and increasing in number.

DR. HEIMANN: I wonder if you would consider item No. 12 on page 4. We have talked about two kinds of air pollution, really -- the non-specific material, that is irritants generally, and then Dr. Kleinfeld mentioned the idea of single sources of community air pollution. He mentioned two communities. Massena, New York, happens to have a large aluminum plan' He mentioned Palmyra, which happens to have a large asbestos processing plant. I wonder if any of you from your own experience can think of communities which might be studied and what they might be. We would like to have some suggestions.

DR. FLORIO: Pueblo, Colorado, has a steel mill and that is all it has. It is a big one.

DR. FRYE: There are various areas in the south where the oil industry and refineries are pretty well localized. I can think of several towns where there are certain areas that would be pretty well covered. The Esso plant at Baton Rouge is one area. Then there is our Kaiser Aluminum area which puts out a tremendous amount of particulate matter which I don't think has been studied very carefully. Those are single industry areas.

DR. HEIMANN: Where is the Kaiser plant?

DR. FRYE: One is at Chalmette and one is being built up in Lutcher.

DR. BRESLOW: The Kaiser Steel Mill at Fontana, California is also a single industry, as well as the diatomite industry in Lompoc, California. Dr. Cooper is familiar with that. Several northern California communities have exposure to lumber refuse.

DR. HEIMANN: The work is done right in the community.

DR. BRESLOW: The cutting and the burning of the refuse.

DR. FRYE: Another lumber area pretty well isolated is Bogalusa, Louisiana.

DR. FLORIO: Do you want alfalfa drying industry that smells horrible? It may not have any effect on health. I wouldn't have the slightest idea. It certainly is obnoxious. I think it is in Western Nebraska. I am trying to think of the route number where you go by miles of these things.

DR. HEIMANN: If they are out in the country it doesn't do us any good. You have to have people close by.

DR. FLORIO: You would just have small towns there. You wouldn't have that kind of industry in a large town. You sure get that smell over long distances.

DR. GILLIAM: How about some of these carbon black places in Texas?

DR. HEIMANN: We have those in mind.

DR. GORDON: Tanneries.

DR. HEIMANN: That would be Gloversville, New York.

DR. DUBLIN: There are a couple of questions that come up in my mind. When you talk about communities that really touches on the engineering aspects of this problem and its relation to epidemiological studies. I wonder if meteorological and other environmental factors have a very important bearing on this problem of air pollution. Have communities really been carefully surveyed in the sense of being able to make topographical maps of the zones within a geographic area which are highly polluted and the areas where the problem is not as severe?

The thought that I have in mind is that I sometimes think we are likely to lose sharpness of definition if we take a whole community. Where we are taking a whole gamut of different things they are averaged out and we lose the comparison. If air pollution is in part a physical phenomenon which is subjected to environmental factors of temperature, humidity, air current, topography, and so on, you may be able to do some differential studies within communities which could be measured against certain objective measurements of air pollution.

DR. GORDON: You are not forgetting this fact of density, which seems to me one of the most important?

MR. MACKENZIE: Intense measurements of the kind you are talking about, in general, in most communities are not available. With respect to the variability, I think we can say one or two things. To cite as an example one community that has been talked about here today, namely, Detroit. The two areas in which the epidemiological comparison has been made in Detroit, namely, the area of so-called high pollution and the one of lower pollution, actually do not have as much difference in pollutional characteristics as one might expect. Furthermore, in either of the areas the variability from one time period to another is of a much greater range, varying, let us say, five or six fold in concentrations of the pollutants that were measured, much more than the difference between the two particular areas that were being compared. Even in the area of so-called low pollution, for a fair percentage of the time the level of pollution would be greater than the average in the so-called area of high pollution.

These detailed measurements in general are not available in most communities.

DR. DUBLIN: The point I am driving at I am sure is quite obvious. We know that many diseases have zones of aggregation in population groups, and somehow or other we might differentiate population groups between those within the same community, if you will, who are exposed to a certain physical air pollutant and compare those against individuals who are not exposed.

DR. HEIMANN: Tom, broadly this is being considered the number one item on the first page of our proposed research project. Intra-city comparisons, possibly census tracts.

DR. DUBLIN: I am not talking about census tracts because then you lose the fact we are trying to get at.

DR. HEIMANN: You mean actually where the topography and weather are such as to make a difference?

DR. CIOCCO: How could you delineate the perimeter of a certain level of pollution? Is that what you are talking about?

DR. DUBLIN: That is right. If you use the census tract by itself you may lose completely the sight of the pollution factor; but, if you determine your census tracts on the basis of the pollution factor and then make your study that is another situation.

MR. MACKENZIE: There are certain areas in which more intensive studies have been made than in others. Perhaps again, the primary area in which most intensive measurements have been made is Los Angeles. Certainly you can pick out within the Los Angeles area where the measurements have been made for several years. There are certain sections in which the pollution both on the average and with respect to maximum intensity, generally, will exceed those in other parts of the same general area.

DR. FLORIO: By a very great amount?

MR. MACKENZIE: A considerable amount.

DR. FLORIO: Comparisons of that sort might be very important if you got some clues.

DR. BRESLOW: There are differences among the people and all other aspects of the situation. The best we have been able to do with the environmental data in Los Angeles is to draw a line across the map and say on this side of the line generally it is heavier and on that side of the line generally it is lighter. The epidemiologist even has to draw the line.

Then the people travel back and forth across the line in Los Angeles. A high proportion of the people live in one area and work in another. The people in Pasadena, where the pollution has been the heaviest over the years, are of quite a different character from the people who live in Santa Monica or some of the other areas where there has been less air pollution over the years. All these aspects enter into the situation. It is difficult to make not only inter-city but intra-city comparisons.

For long-term effects you almost have to turn to what Dr. Mancuso has been getting at, and that is residence exposure. For acute effects actually we are not willing to draw the line. We take just the whole Los Angeles basin and make the observations there. For long-term effects, we feel that the residence exposure is the critical element rather than the place where you live now. Drawing the line has not served any great purpose.

DR. DUBLIN: It seems to me there is a study element there. You are willing to say that these make the differences. I wonder whether those things should not be subjected to study.

DR. BRESLOW: That is correct.

MR. MANOS: One approach we had thought of is just to take a city and look at a lot of the death statistics that they keep; look at it by census tracts, and look at it for differences first, before we worry about the causes, and do that on a mass scale. That would be fairly easy to do. Where you find differences, if you do it by census tracts, you could get good data on socio-economic factors which you can roughly compare with other census tracts. If you find some differences which are suspect, then you try to see if there are differences in socio-economic factors. If you find areas where there are differences in mortality and they are similar socio-economically, then you look further to the location of industry relative to those places. You can follow mortality through time, which is another good check. That is, presumably if air pollution has any effect on mortality, the correlation between variations in air pollution from year to year or month to month should be more closely related to mortality in a census tract that has air pollution than in a census tract that does not have air pollution. Once you know the location of industry you can make rough estimates of the variation from year to year based on weather factors.

These are things that you can do fairly easily. You might call it playing with data which are already there. How much should we here go into that sort of thing?

DR. CIOCCO: As much as you can. I think we should be very honest and say we are on a fishing expedition. There are many things you can do. It has been developed today that so little is known that you can hardly do anything wrong. The only danger is that you come up with the wrong interpretation.

MR. MANOS: That is the second problem.

DR. CIOCCO: As long as you can get a certain series of observations and let someone else worry about the interpretation, I think you can take that step all right. We broke Pittsburgh down according to morbidity rate from cancer on the basis of the 1947 survey. We could not relate intra-city differences to socio-economic status. We could not relate it to air pollution, at least on the basis of the data that were available there. There are differences, though. I am really curious to know to what those differences are due.

DR. GILLIAM: Was the lung cancer related to socio-economic status?

DR. CIOCCO: Some of the worst socio-economically didn't have any. It was both ways.

MR. MANOS: We have done some preliminary talking on this very same subject with our engineering counterpart. There are things we can do from which they would not promise anything, in the line of just plain looking around, rough estimates.

DR. HEIMANN: For small areas.

MR. MANOS: Until the time when there would be more measurements.

DR. FLORIO: Could I give this thing a somewhat different twist. It seems to me that we are trying to find a justification for getting rid of air pollution. I don't think that justification is needed. Certainly my friends will think the statement sounds strange coming from me, but perhaps we should be more interested in how to get rid of air pollution while concurrently trying to find out if it has any health implications. People frankly don't care. They, I think, feel it has health implications; but whether it does or doesn't they want to get rid of air pollution. We haven't worried too much today about getting rid of it, have we?

MR. MACKENZIE: Could I speak to that. I think there is no question that we recognize the circumstances as of today corresponding to the position that you have outlined. The people want air pollution controlled. I think what we are talking about here, however, is something that is probably going to assume increasing importance in the future because as industry continues to develop and urban populations to grow in this Country, we feel that ultimately in certain of the areas the capacity of the atmosphere available to dilute and disperse contaminants is going to be reached and, furthermore, even with controls to the extent to which they can be carried on economically. These things cost a great deal of money to accomplish, and that will determine to some extent how far you can go that way. Ultimately you will need really definitive answers about the quality of air that you need for various purposes, one of which certainly is tied in with the public health. I think that there are not many places right now where you need the answer. Ultimately, however, I think it will be essential that information of that kind be available.

DR. FLORIO: I don't quarrel with that for one instant. In fact, I am much more interested myself in the health implications than I am in other implications. Now is the time to do it when we have situations such as we have in Los Angeles, exploiting that situation in every way to learn everything possible about what is happening to the peoples' health.

DR. SMITH: Lloyd, you don't have to worry about it. Actually two-thirds of this is going to engineering and one-third to medicine. The same thing is true with the California appropriations. We are having to do our utmost in California to get the public health aspects into the act.

DR. FLORIO: I would fight just as violently the other way if that were the case. I would be fighting to spend the money on health. I just wanted to see that that aspect was at least mentioned here today.

DR. FISHER: Gentlemen, we seem to have run through the "discussion outline"

The intent of this meeting was to start talking out some of our unresolved problems in community studies. We had no idea we would come up today with a firm working program. We will take the liberty in the near future of trying to get in touch with you to meet with us again, if you are willing to, and consider some of the specific program sectors and some of the specific projects. We are going to need help.

I gather that it is your opinion that we are thoroughly justified in keeping up our toxicological and physiological studies, concurrently getting under way as many of the epidemiological studies as we can. Some of this is going to be opportunistic. We would like to work with you later in trying to set this up on a long-time plan basis. We don't expect an awful lot to come out of our toxicologic studies for a year or two. It takes time to get those going, to get a biologist trained in the ways and means of air pollution.

Is there any parting comment that any of you would like to work off on us?

DR. CIOCCO: I think somebody has already mentioned that you should be complimented for what you have done so far.

DR. FISHER: This has been a most interesting assignment and, if there are no further comments, we will declare this session adjourned.

Thank you very, very much.

. . . The meeting adjourned at 3:45 . . .